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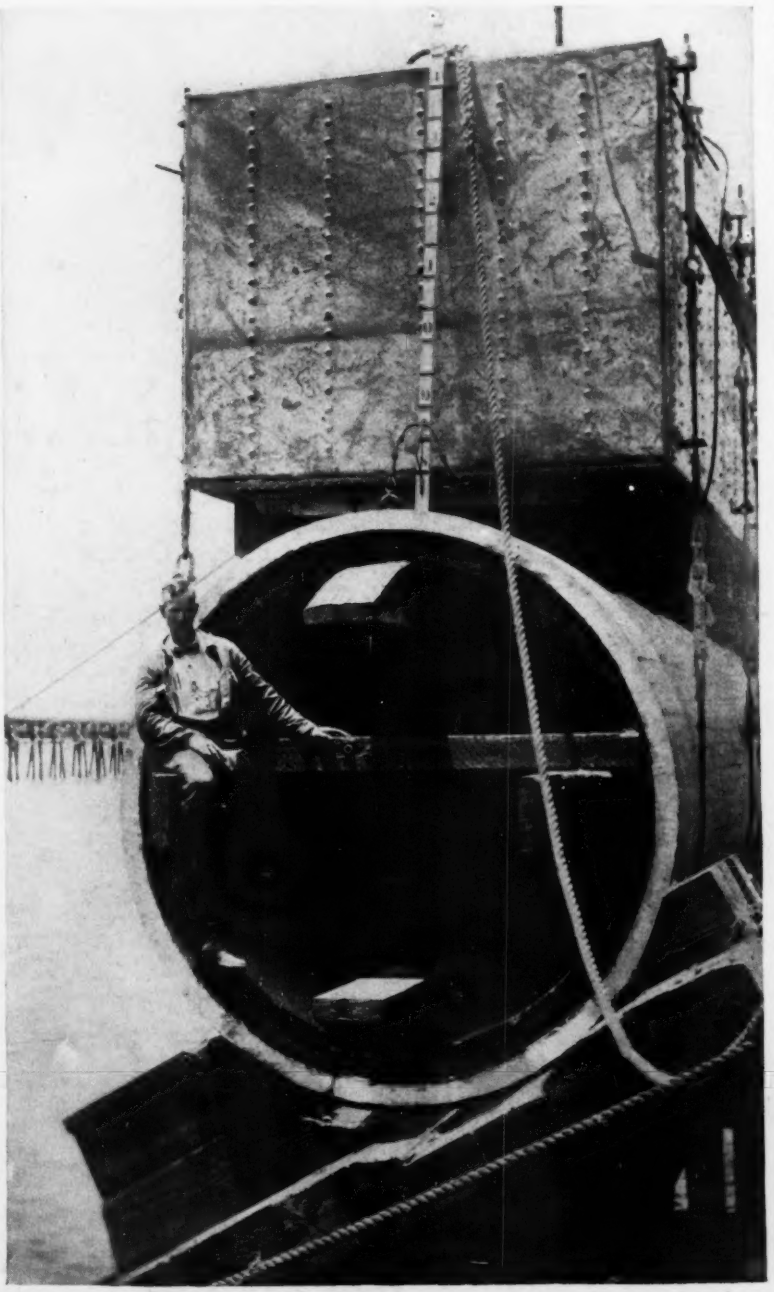
August 20, 1925

Engineering News-Record

Open Sea Construction of an Outfall Sewer

Wide Viaduct Built of Concrete and Structural Steel

Designing Banked Highway Curves for Safety



Sewer Pipe and Pontoon Ready for Launching, Santa Monica Bay, California

Studies in Concrete Tablet Construction

Three Strip Highway Pavement in Massachusetts

Reviews of Recent Books on Engineering Subjects

Ford Motor Co. assembly plant at New Orleans in course of construction. Federal Cement Tile used. Albert Kahn, Architect.

On the great big jobs - - - -

Some representative large installations

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DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

FRANK C. WIGHT
Editor

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No Criminal Negligence Proved

PRECEDENT has been followed in the attempt by the District Attorney in Boston to find someone criminally responsible for the collapse of the Pickwick Club building last Fourth of July morning. Ten of the twelve men indicted were acquitted by the judge without sending their case to the jury and the jury promptly acquitted the building inspector and contractor's foreman about whom the judge had some doubts. Once again it has been shown that it is practically impossible to convict anyone for a building collapse, and once more it has been demonstrated that centering of responsibility on a capable and expert individual is the best insurance against accidents, not only because that individual would be less apt to make mistakes but because it would be so much easier to determine guilt if he did err. The judge and jury in Boston had to consider an indictment against a mixed lot of dance hall owners, building inspectors, architects and contractors. Naturally, they found it impossible to determine guilt or even to fix the cause of the accident, especially when two such eminent engineers as General Goethals and Professor Swain expressed themselves at complete variance as to that cause.

Crushing or Side Pressure

LOOKING aside from the legal aspects of the Pickwick Club case, the advantage of the engineering argument as to the cause of the collapse seems to rest with Professor Swain rather than with General Goethals. To disregard the overpowering side pressure of a fourteen foot fill of blue clay and sand in favor of the crushing failure (under a load of 250 lb. per sq.in.) of a concrete which every one but General Goethals found at least of average quality seems to be rather far fetched. Concrete so rarely fails in direct crushing that such an explanation should not be sought unless all others fail. The side pressure of earth, on the other hand, is so persistent and its powerful effect so commonly the cause of failure that it should not be ruled out by the opinion even of an expert so impressive to a lay jury at least, as the late head of the Panama Canal.

Typhoid Cases Increase

A NOTABLE excess of typhoid fever in the United States for the first six months of 1925 compared with the same period in 1924 calls for searching inquiry on the part of all responsible authorities. For "at least two decades," *Public Health Reports* for July 17 states, typhoid cases and deaths have been decreasing. Presumably the Public Health Service will go further than to publish the weekly comparative figures, and to state that "while many sections of the country have shown some increase over last year, the greatest difference in recent weeks has been reported in the South Atlantic and East South Central States." A bit of possible explanation of the excess is afforded by the remark in *Reports* that "some of the increase" may be due to better reporting. Doubtless, but only "some" of the excess of 1,530 (7,490 against 5,966) in the 32 to 34 states reporting and 490 (2,253 against 1,763) in the approximately 102 cities reporting can be due to better reporting. If the figures for the cities are included in those for the states, as we assume, then apparently most of the excess typhoid is among the rural and small-town population. The cities, however, should not relax their vigilance on that account, for their increase for the six months is above 20 per cent, and in the week ending June 20 nearly 40 per cent over like periods in 1924. The previous week was slightly under 1924, but both of the first two weekly reports for June were relatively high. Although no water-borne typhoid outbreaks that would account for the increase have been reported in the last six months, yet water and health authorities would do well to increase their vigilance looking for possible dangers from this source.

Query

IF THE rail rates on anthracite substitute coal moving eastward have been too high why has not the Interstate Commerce Commission lowered them before now? If they have not been too high, why should the railroads be penalized now by the Commission in order to scare the anthracite coal industry into a settlement of its difficulties?

Engineering Works Tablets

ENGINEERING is growing more conspicuous. This is because large engineering structures are multiplying but more because the automobile is bringing increasing thousands to the sight of these structures. With this condition of increased prominence there comes the need of clear designation and definition. The traveler whose eye is struck by the sight of a great reservoir dam or a wide span arch is keen to know its name and purpose, and it is doing more than satisfy a pardonable curiosity to tell him these things. It is making known the engineer's work and its great part in modern industrial and civic development. No lack of modesty or breach of dignity need lie in the performance. Certainly the most retiring technical worker need not have his diffidence disturbed by a tablet such as on another page is shown marking the Germantown Dam of the great flood protection works of the Miami River valley. As it did in a number of major ways, the Miami Conservancy District, in designing these tablets, has in a minor way worked out a problem for engineers. The article on another page is a story of research and so has a value much beyond the insignificance of the structures described. By it the art of making a memorial tablet of concrete, not as a factory task of fine molding, but as a field operation in ordinary engineering construction, is put on a practicable basis.

Cleveland Politicians Outvoted

THE BEST laid plans of mice and politicians still go wrong now and then, even when laid in August, the month when all the city dwellers who can get away take vacations and many of those left behind succumb to the attacks of general apathy. In proof whereof we cite the defeat at Cleveland, Ohio, on Aug. 11, of a charter amendment designed to return from proportional representation to the good old ward system of electing councilmen. Reports are that the politicians of both the leading parties united to carry the amendment, but though the vote was even lighter than the most hopeful predicted—41,280 out of a possible 200,000—there was a majority of 800 against the change. Ordinarily these light votes are interpreted as showing lack of interest in municipal affairs. In this Cleveland instance it seems to indicate even more strongly a misgaging of public sentiment by the politicians who maintained that a year or so of proportional representation had convinced the public of its unwisdom. The results at Cleveland are all the more significant because, if the politicians had won, then their next attack, it is believed, would have been against the city manager plan. Cleveland is much the largest American city which has adopted either proportional representation or the city manager plan. It is to be hoped that each will be kept in use at least until it has had a fair trial on such a large scale.

The City Engineer Asserts Himself

MUNICIPAL engineering employees are beginning to act collectively to get some alleviation of the ridiculously low salary scale that prevails in most cities. Some weeks ago those in the city of Chicago walked out for a few hours as a demonstration of their predicament, and now representatives of the 3,000 engineers in the employ of the city of New York are making the formal and dignified protest noted in our news columns this week. It remains to be seen how successful will be either method but it can hardly be doubted that there is here the beginning of a movement that must soon begin to have an effect on city administrators either directly or through the force of public opinion. The New York figures are significant. Engineers, that is every employee so rated in the civil service list, averages less in salary than any other class of trained employee, including skilled mechanics and school teachers. Even admitting, as must be admitted, that the lower ranges of engineering employment do not require professional qualities, this is a ridiculous condition. Political controllers of the city's destinies these days are having a hard time in the struggle between rising costs and the demands for lower taxes, so they are disposed to recognize only those employees who represent some voting strength, but the forceful presentation of such figures as the New York men have collected will require some consideration by the most demagogic of mayors and councils. Engineering, especially engineering in the large city, is overcrowded, probably. But then so is school teaching and so is the legal profession, yet each of these is managing to get a better approximation to a living wage. The city engineer in the past has taken his lot supinely and his wage position shows it. Now that he is beginning to assert himself possibly he will begin to get some results that will be worth while.

Communal Professional Service

ENGINEERS will be interested in the account on another page of the novel venture of the architects in Los Angeles to contribute their communal services to the betterment of public architecture, not because that venture in any way overlaps the engineering field but because it may serve as a model of what to do or what not to do for engineers seeking similarly to benefit the community.

The purpose behind the formation of the Allied Architects Association is commendable. Architects, like engineers and other professional men, are beginning to recognize that they have a responsibility to their community which is not altogether satisfied by the proper performance of their individual duties. Experts in any field will see things being done or left undone by public authorities which those authorities either do not see or choose not to recognize but which the people themselves would be the better for knowing. To watch the community progress from the specialist's vantage point and to convey the views so gained to the people from time to time is a proper professional activity and more and more engineers, for one profession, are engaging in it with success.

But the Los Angeles architects have gone much further than this. Not satisfied with voluntary comments on the public architecture of the city or even with generalities of plan and design which will serve as guides for detailed follow-up, they have formed themselves into an architectural firm for the prosecution of all the functions of an architect as he is related to certain city or county buildings. They plan, they design, they supervise construction and the city or the county pays them the same fee that would be paid the private architect who would otherwise be retained to do the work. This is a startling innovation, which deserves consideration.

We will not emphasize too much the question of the encroachment of the group on the individual's privileges. Since the architects of southern California seem voluntarily to have gone into this combine it is to be assumed that the competition or the possible loss of private business do not weigh heavily upon them. But we foresee in less idealistic communities a very real antagonism on the part of those practitioners who might reasonably get the credit—and the cash—for the design and supervision of a five million dollar public building. We will not compare too strongly, either, the plan with a possible proposal that all the grocers in Los Angeles combine to furnish the city institutions with groceries at cost as their contribution to the community growth and prosperity, though after all the grocers and the stationers and the realtors have things to sell the city and they, too, might feel their craft or guild responsibilities so great as to contribute at least their services and profits to the city or to pool them for the upbuilding of the guild or craft. What we do question, though, is something that the architects do not seem to question at all, that is, whether this designing and building by convention assembled is superior to the ordinary method of centralizing responsibility on a responsible individual.

Every institution, said Emerson, is the lengthened shadow of a man. Every engineering, and even more so, every architectural conception or project must have the individual's impress. Sometimes that individual is

not a single human being, it is a group of human beings but that group is joined together by the bond of a common purpose and a common profit. The associated architects of Los Angeles may have the common purpose—indeed, they must have or else they would not have ever come into being—but the common profit is the highly intangible one of the bettering of their community. We would not for a moment decry this high purpose; it is admirable and we wish it were more common, but men being as they are and even architects being as they are we doubt if year in and year out it will serve as faithfully as a goad to excellence as the individual's desire to further his own profit. That profit is not merely money; it is reputation and the glory that comes from work well done and the elevation of spirit that every engineer and every architect feels when he looks on his own finished work and knows that it is good.

More than that, speaking for an engineering plan on which we presume to have some knowledge, we seriously doubt the superiority of the group design, winnowed out through countless meetings at which the majority rules, over the individual effort—if the individual is the right one. We have read some of these stunt novels, where every chapter was written by a master novelist, and they were rarely as good as any one of the experts could have written himself. We doubt if an artists' committee could have painted "The Last Supper." So with all due respect to the architectural talent of Los Angeles, and disclaiming any specific comment on any one of their group efforts, we would expect the best of their individuals to better the work of the assembled congress of them all.

The architects of Los Angeles have embarked on an interesting adventure, but it is one that will hardly tempt many of their professional brothers or cousins.

Approaching the New York Freight Problem

THE Port of New York Authority has picked out of its "Comprehensive Plan for the Development of the Port of New York" the one part that promises the earliest and best solution of the problem of relieving the freight congestion in and around New York City. Its latest report emphasizes the universal freight stations in Manhattan Island and discards the automatic electric railroads by reason of the cost of providing such rail connection. Connection between the inland freight stations and the trunk line railroads in New Jersey is to be provided by unit-container trucks which will travel from New Jersey to New York either by ferry or through the vehicular tunnel. Such a system of handling freight is already in effect, the Erie, Lackawanna, and Lehigh Valley having individual inland freight terminals on Manhattan Island reached by trucks from New Jersey.

This new plan, or as the Port Authority prefers to call it, this partial effectuation of the Comprehensive Plan, through the abandonment of the expensive and untried automatic electric underground railroad and the substitution of an accepted and tried out method of handling freight, stands a good chance of being adopted. Moreover, by adjusting it to fit in with the plans of the commissioner of docks of the City of New York for a union produce terminal, and of the borough president of Manhattan for changes in the New York Central tracks on the west side of the island, the Port Authority gains the support of at least part of the city administration, hitherto viciously antagonistic.

The terminals which the Port Authority proposes to build are to be large modern loft buildings with only the basement and ground floor given up to freight-handling purposes and the upper floors available for renting. Such an arrangement will simplify financing that part of the project. The method of financing the whole project, however, is treated with the same vagueness which characterizes most Port Authority statements. The practicability of the plan would have appeared more certain if the report had shown how this all-important question is to be considered. To be sure, the plan calls for the railroads to absorb all the costs except that of the nine freight stations, unofficially estimated at $8,000,000 each, but as each part of the plan is dependent on all the others, and as the railroads are having difficulty in raising money for their every-day needs it would seem that some method of financing the whole project should be presented. Financing the nine stations is no small item in itself.

The plan, despite its apparent advantages, has another feature that needs further consideration. It proposes to handle practically all the freight now reaching Manhattan Island by means of carfloats, a total of something like 830,000 cars annually, on trucks which will have to cross the river on ferries or through the Holland tunnel. Assuming that these cars bring in 30 tons apiece and that this freight is to be handled from the break-up yards in New Jersey to Manhattan Island in 5-ton trucks, around 16,000 truck movements a day will have to be made across the Hudson River. The ferries are already taxed beyond their capacity for expeditious handling and such a movement through the vehicular tunnel in an 8-hr. day would be over half its estimated capacity, probably more nearly equal to its entire capacity for handling such large trucks. Moreover, if any considerable part of this truck movement were to be made through the tunnel it would create a new street traffic problem in the lower part of Manhattan Island. Evidently then some other way of getting the trucks across the river must be provided if the plan is to be a success. Possibly the general acceptance of the plan is to be used as an entering wedge in a drive for bridges or more vehicular tunnels, or even more ferries, though most of the official and business bodies around New York seem to have taken an unreasoning dislike to this flexible and convenient mode of travel.

Finally, the plan must be sold to the railroads, for although some of them already have such a method of freight handling in effect they are for the most part the ones who lack strategic positions in regard to Manhattan's freight. Others, notably the New York Central with its freight line along the west side of Manhattan Island, will have to be shown that at least a part of the estimated economics will accrue to them. Railroad managements are notably bull-headed about accepting such radical changes and they cannot be expected to scrap their car floats, give up their costly waterfront property and structures or alter the mainland terminals until they are convinced that the proposed scheme is sufficiently better than the antiquated one now in effect to warrant their doing so.

Academically speaking, then, the Port Authority's scheme is commendable. Whether or not it will work depends upon the strength of the Authority and its ability, hitherto non-existent, to transform a paper program into an actuality.

Open Sea Construction of a Concrete Pipe Sewer Outfall

A Mile of 7-Ft. Pipe Line Laid Outshore on Exposed Coast by Submersible Pontoons and Submerged Towing to Prevent Damage from Heavy Ground Swell

By H. A. Van Norman
City Engineer, Los Angeles, Calif.

LAYING an 84-in. concrete pipe sewer a mile into the ocean from an open shore offered an interesting problem in construction last year at Santa Monica Bay, the ocean front of Los Angeles, Calif. The pipe was placed in trench about its own depth on an evenly sloping bottom, with a maximum depth of 60 ft. of water at the outshore end. There were absolutely no wind or water breaks. Surf, ground swell and heavy north and south coastwise currents were the normal water conditions much aggravated when storms came on. These hazards were met without serious mishaps by a method of submerged towing — lengths of pipe being hung from the bottom of a special pontoon which went under with its load and left it in position in the trench.

The new outfall is a part of the sewerage improvement of Los Angeles. It takes the discharge of the Hyperion treatment plants on the bay shore over a mile out into the waters of the Pacific. Precisely the main trunk outfall is 5,443 ft long, 7 ft. in diameter. Then it forks into two branches 5 ft. in diameter and 114 ft. and 310 ft. long. The plan called for an equal-armed *Y* but current conditions hindered the construction of the northwest arm to its full length, Fig. 1. At the shore the sewer is under gravity pressure from the treatment plants—the head is 34 ft. at lowest low water and 9 ft. less at highest high water. Besides the arms of the *Y*, which have an *L* up-turn at their ends, there were left plugged openings in the tops of the second, sixth and tenth sections of 7-ft. pipe preceding the *Y*. The estimated ultimate working discharge is 500 sec-ft.

A contract time of 300 working days was specified. First the plan of construction called for a cofferdam from the shore to beyond the breaker line, some 800 ft. This took care of the surf difficulties. Plant assembly, shore work and cofferdam construction occupied the time from Aug. 11, 1923, when work was begun, to April 24, 1924, when the first outshore pipe in the cofferdam was laid. This event, however, was preceded in March by one storm that broke the moorings of the derrick lighter and drove it ashore, completely demolishing its water scow. Eight driven sewer foundation piles were broken off, and some of the steel sheetpiling was toppled over. In April some piles of the launching pier with 22 ft. of penetration were raised 3 ft. and the clamshell dredge was driven ashore. In May, spur piles had to be driven to stiffen the trestle.

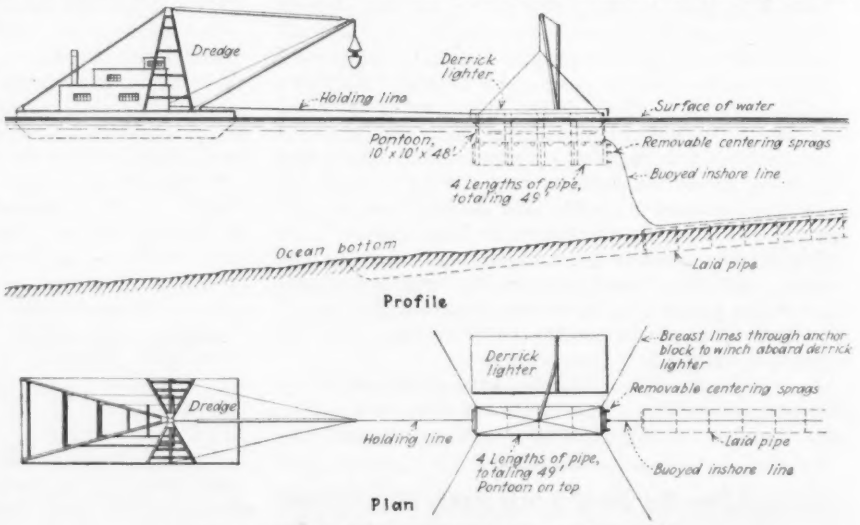


FIG. 2—PIPE LAYING OUTFIT AND PROCEDURE

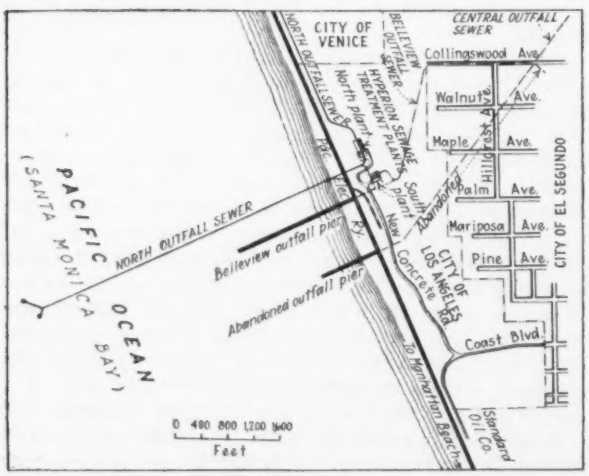


FIG. 1—PLAN OF OUTFALL SEWER AND TREATMENT PLANT

Shore and Cofferdam Work—The first construction was a trestle extending 800 ft. through the surf. This carried the waling guides for the cofferdam sheetpiling and tracks for traveler and cars. At its outer end was a launching platform. For the cofferdam steel sheetpiling was used in the heavier surf and wood sheetpiling on the beach. Excavation to subgrade was made within the cofferdam by suction dredge, sand formation only being encountered.

The chief interference in this work was pockets of kelp and other seaweed, as long as 20 ft., which had been buried some 8 ft. by previous sluicing of sand from the screening plant site. This seaweed made it necessary in places to abandon the suction dredge and use a half-yard clamshell bucket working from a traveler.

At the shore end it was necessary to cross the right-of-way of the Pacific Electric Ry., below sea level. The excavation for this part of the work was done in tunnel by the city's construction organization, aided by pumps and heavy timbering. The chief difficulty encountered

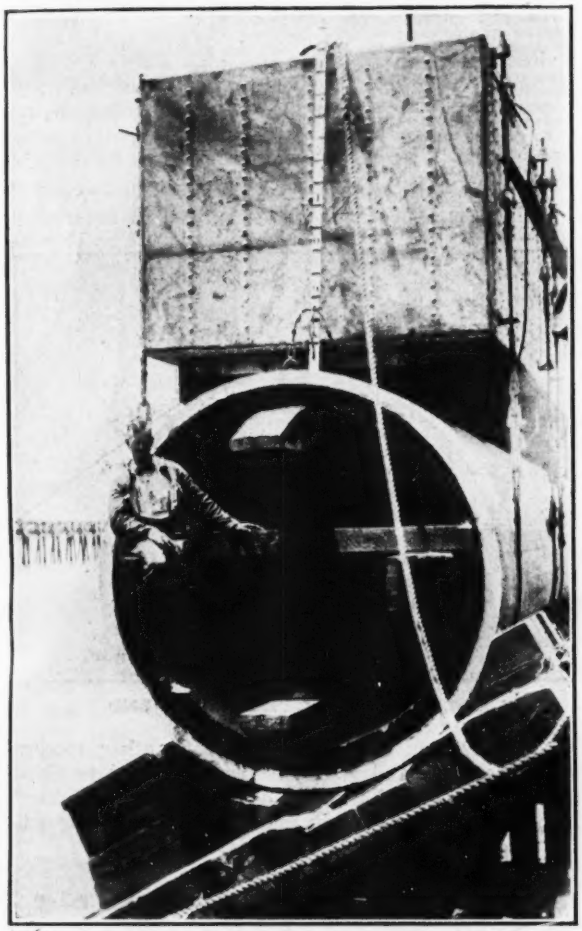


FIG. 3—PONTOON AND PIPE ON LAUNCHING WAYS

was running sand on the tunnel floor which was the only part of the tunnel that was not closely sheeted. It was found that this sand could be held by a layer of crushed rock on the floor. The pipe was then slid into place in the tunnel and jointed.

The precast reinforced-concrete pipe used for the sewer was furnished in the manufacturer's yard on shore, which was fully described in *Engineering News-Record*, Aug. 21, 1924, p. 296. It required tipping by special frame, loading and transporting on flat cars from this yard, a short distance to storage yard alongside traveler tracks extending from the beach onto the cofferdam trestle. The pipe was thus transported and subsequently laid in the cofferdam in single sections, the foundation pile bents, specified in the breaker zone, being jetted and driven into place and capped, with drift bolts to secure the caps, in advance of the pipe laying.

Open Sea Operations—Seaward from the cofferdam, excavation was by a 4½-cu.yd. clamshell dredge, the clamshell scallops being removed by a suction dredge on the derrick scow that stood alongside the pipe laying operations, with derrick, air compressors and other required equipment. Excess excavation was refilled in bedding the pipe by jetting sand from the bank. The only difficulty arose when a tough clay formation extending some 1,700 ft. was encountered, and the suction dredge could not remove the scallops, which interfered with the bedding of the pipe. After some experimenting it was found that air spades operated by divers were the best solution of this difficulty.

In general, as the excavation progressed, the depth was tested by a sounding line. A straight-edge 50 ft. long was then lowered, one end being placed on the invert of the last pipe laid and the other end placed at the sounding line whose location on line was determined at the surface by sighting on ranges on shore. A sounding was then taken on the undisturbed bottom of ocean about 50 ft. to one side of the sewer line; and 10 ft. below this elevation was taken as the proper elevation of pipe subgrade. The ocean bed had a uniform slope and therefore was a convenient and practical means of insuring uniform pipe gradient and ample excavation. By reference to the straight-edge on line and grade, it was possible to correct any unevenness and make a proper bed for pipe assembly.

As stated, a launching pier was constructed at the offshore end of the cofferdam pier and was provided with a 35-ton stiff-leg derrick, cables, falls, cradle skid, steam winches and special launching grease for the ways. To the pier were attached five standing ways having a declivity of 30 deg. and extending 20 ft. below water. These were supported by piles.

It was first planned to guy the derrick on the pier to dolphins, but heavy seas in May delayed the placing of the dolphins and caused this plan to be abandoned. A stiff-leg was set at right angles to the sewer line and attached to a nest of anchor piles driven from the traveler. To support the other stiff-leg, a similar pile anchor was driven alongside the sewer line. In addition, guys were attached to the existing outfall sewer pier 400 ft. away at additional cost for lines, but saving the cost of placing and removing dolphins. This derrick materially helped in completing the launching pier.

The assembly of four sections of pipe was made on the cradle skid in an elevated position, by the stiff-leg derrick. Bitumastic jointing compound was used in the pipe joints which were pulled tight by three threaded rods through eyes provided for in the pipe manufacture. Laying the pipe in the dredged trench followed within about 200 ft. of the dredge, Fig. 2, the pipe being launched and transported beneath a pontoon of riveted steel, specially built for the purpose. Fig. 3 shows a section of four pipes ready for launching. Two pontoons were used alternately and each weighed approximately 38 tons, measuring 10x10x48 ft. and had five compartments fitted with water valves through which water could be admitted or ejected by compressed air.

This method of placing the pipe made the operation largely unaffected by the swells on the ocean surface, as would have been the case had the pipe been slung from a boom on a barge. It also permitted placing four lengths at one time, which was necessary to provide ample weight to be unaffected by the heavy swells.

After being towed to position over the prepared pipe bed alongside the derrick lighter, the lines indicated in Fig. 2 were attached to the pontoon for its control. The inshore line was steel and buoyed and extended to a winch on the launching pier 800 ft. offshore, and was used to pull tight the joint with the pipe already

laid. The holding line was hemp and was used to prevent impact at the joint due to heavy tidal flow. The breasting lines were hemp and were used to place the pipe on line. The lowering lines hung from the derrick boom, carrying some of the weight of pipe assembly which increased with submergence, and permitted vertical movement.

When the lines were all connected, the pontoon was slowly flooded to negative buoyancy. The air valves were then closed and the pontoon allowed to sink slowly, held by the lines on the boom, until at rest on the bed of the trench with the inshore end about 4 ft. from previously laid pipe. The divers, one on each side of the closure, then indicated by telephone the amount of strain to be applied by the different lines in making the closure. When closure was made, the pontoon was filled with water preparatory to casting off the lines supporting the pipes. The pontoon was then floated and all the attached lines were cast off and moored. The pontoon was then towed back to launching pier.

Pipe laying opposite the existing outfall piers was hindered by the murky condition of the ocean water, fouled by sewage which reduced visibility. There was also the sewage field on the bed of the ocean, which made it difficult properly to joint and bed the pipe. However, the last length of pipe was laid Nov. 14, 1924, about seven months after first length of pipe was placed. In all there were laid 420 pieces of 84-in. x 12-ft. 3-in. pipe, 32 pieces of 60-in. x 12-ft. 3-in. pipe, one 85 x 60 x 60-in. *Y* and two 60-in. *L*'s. Fig. 5 shows one of the *L*'s being submerged. For purposes of measurement of sewer line, deep soundings from a boat were

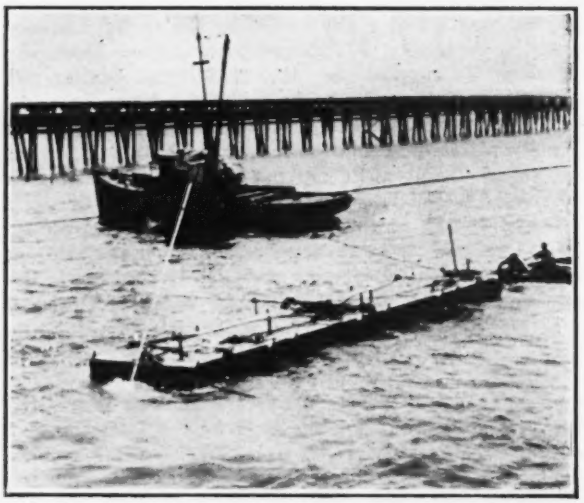


FIG. 4—PONTOON AND PIPE READY FOR TOWING

found to be unreliable on account of the drift of the sounding line; so, as a standard of measurement 12.275 ft. was used for the length of each pipe laid, representing the pipe length plus creepage. This latter was determined by the measurement of some of the inshore work.

The contract price for the project was $496,000, and in making progress payments to the contractor it was necessary to agree on a schedule of payment for the various classes of work performed. The schedule adopted was as follows, each classification including distributed charges for equipment, supervision and overhead:

Construction of cofferdam and trestle, including driving of piling and sheet piling, excavation and bulkheading	$180.36 per lin.ft.
Driving and capping of foundation piles	35.43 per lin.ft.
Laying pipe in cofferdam	18.04 per lin.ft.
Trenching outboard of cofferdam, including dredging	27.41 per lin.ft.
Erection of assembly pier, launching pier and launching ways, lowering machinery, derrick and appurtenances	$15,800.00
Laying pipe from cofferdam outboard, including removal of pipe from beach storage yard to assembly pier, assembly launching, towing and laying pipe in place	29.25 per lin.ft.
Handling of pipe in storage yard, including tipping, removal of forming rings and rolling	1.91 per lin.ft.
Delivery of pipe to storage yard, including loading of pipe on cars, shifting to yard, unloading and placing on beach	0.70 per lin.ft.

The value of completed work was determined by applying the above rates to measurements reported by

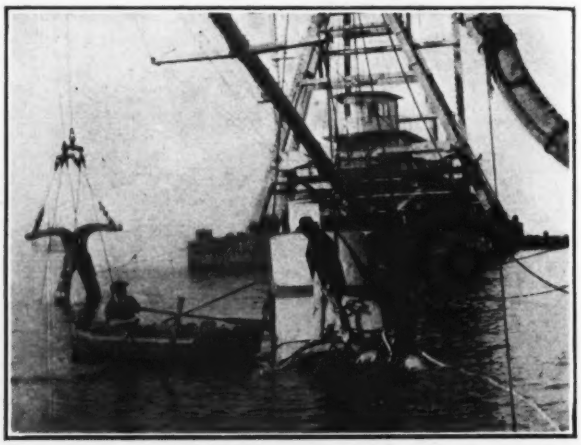


FIG. 5—SINKING L-PIPE AT SEA END

the inspector on the work. As with other sections of the north outfall sewer, 25 per cent was retained. The work was done by the Merritt-Chapman & Scott Corporation of New York, under the personal supervision of the city engineer and his engineers.

Sliding River Banks Dictate Cantilever Bridge

In the construction of a highway bridge across the Red River of the North at Pembina, N. D., by North Dakota and Minnesota, a special design problem arose through the tendency of the river banks to slide. As stated in the recent report of the chief engineer of the North Dakota Highway Commission, most bridges on the Red River of the North are affected by lateral movement of the banks toward the river. In the most extreme case, that of a bridge near Drayton, the pier on the west bank moved nearly 12 ft. from its original position in the course of time. All piers in the banks moved some, whereas piers in the water were free from appreciable movement. Because of this condition it was decided that the piers of the Pembina bridge should be located within the river width and the bridge should contine beyond these piers to firm ground without piers in the banks. A cantilever type of bridge was found to meet the requirements. The bridge as built has a main span of 252 ft. and two cantilever arms of 180 ft. each, flanked by concrete approaches of 66 and 90 ft. respectively. The design was prepared by the North Dakota Highway Department and approved by the federal Bureau of Public Roads; it was built by the Linton Bridge Construction Co., of Linton, N. D., at a cost of about $175,000.

Bridge Construction at Pittsburgh Encounters Much Red Tape

Many Authorities Must Be Consulted, from War Department to State Boards and Local Art Commissions

MANY detail legal and civic negotiations must be gone through in proceeding to build a bridge over any navigable stream. Conditions in Pittsburgh (and perhaps elsewhere in Pennsylvania) make these preliminaries exceptionally complicated. The people at large expect construction work to begin immediately after they have voted the funds, but various requirements make a long delay inevitable.

Norman F. Brown, director of the county public works department, Pittsburgh, outlines in the following statement the procedure required.

To build a bridge over a navigable stream, a charter must first be secured from Congress—passed by both the Senate and the House of Representatives and signed by the President. This charter, however, is only provisional, and requires that the plans of the bridge be approved by the War Department engineers, and that is done only after the Chief of Engineers, through his local representative, holds a public hearing, which is properly advertised for three weeks in the local newspapers. To this hearing are invited all interested parties, who may be in favor of the plan or opposed to it. If the plans do not have to be changed they are then sent to Washington with the recommendation of the district engineer officer for approval, and are then passed upon by the Chief of Engineers and forwarded to the Secretary of War for his final approval.

The War Department, however, will not issue this permit for a bridge in Pennsylvania until the structure is first approved by the Pennsylvania water and power resources board, and this body will not approve a bridge in Pittsburgh until the plan is satisfactory to the city flood commission. The War Department is interested in the navigability of the stream for commercial development and national defense, while the flood commission and the water and power resources board are interested in preventing damages which might be caused by obstructing the stream's flow or altering the water levels on adjoining lands.

Planning Commission Approval—The above mentioned approvals take into consideration the effect of the bridge upon the river. But as the bridge also carries a public highway which must be properly interrelated with existing city streets and county highways, the plan is next submitted to the county planning commission, city planning commission and the citizens committee on city plan for the consideration of its effect upon traffic conditions. The planning commissions take under consideration the location, width, grade and approaches as well as the paved roadway of the bridge. To expedite their considerations, the three planning commissions appointed a committee with representatives from each, known as a joint planning conference, and it is before this joint planning conference that the plans of the bridge are presented and discussed. After these deliberations take place in this conference the plans are considered by each of the constituent bodies of the three major planning commissions.

It can be appreciated by all concerned that before pier locations can be submitted definitely to the War Department, the roadway which these piers must carry is first to be made acceptable to the planning commission.

After the planning commissions have approved the bridge as to its roadway and approaches as well as grades, ordinances must be passed by the city council and approved by the mayor so that the grades and lines of the streets affected by the bridge can be established.

Art and Public Service Approval—The plans of a Pittsburgh bridge after reaching this stage are about ready to be approved by the art commission of Pittsburgh. They deal with the structure solely as to its form and esthetic appearances. This art commission is composed of seven men among whom are representative architects, artists, sculptors and business men. In most cases several different studies of a bridge are submitted to the art commission for their consideration before their final approval on a type of bridge is secured. At this stage if any change of consequence as to width, grade or size is necessitated, revised plans must be submitted to the preceding bodies and their approval is an essential requirement for a further advancement in getting a bridge under contract.

All public utilities which cross under or over the bridge require that the proposed bridge be submitted to the public service commission for approval. Numerous conferences are necessary with railroad officials and other utility companies interested before submission to the public service commission, so that, if possible, all companies interested must be satisfied before the plans are submitted for the approval of this commission.

The public service commission holds a hearing in Pittsburgh for the consideration of plans. In almost all cases two or three railroad companies are interested in the proposed structure inasmuch as it crosses over their tracks requiring certain changes in their yard tracks to accommodate the new pier locations and any other matters of vital importance, also adjudication of costs must be determined where a liability rests upon the railroad corporation. This is generally subject to considerable controversy and argument before definite plans and apportionment of costs are finally concluded by the commission.

Legal Procedure—The approval of bridge plans both as to design and construction details must then be secured from the grand jury and court of quarter sessions of Allegheny County before the commissioners are allowed either to advertise or award a contract. Prior to a hearing before the grand jury for consideration of plans, the hearing must be advertised once a week for three consecutive weeks, so that all interested citizens whose property may be appropriated or damaged in connection with the bridge construction may have an opportunity to present their views. After the grand jury gives approval the court of quarter sessions gives final authority to the commissioners and the Department of Public Works to proceed with the letting of a contract and with construction.

At the time the bridge is approved by the grand jury, individual damage claims are not settled. These come later before a board of viewers whose awards, if not satisfactory to either parties, may be appealed to the courts.

Briefly summarizing, after the approval of the United States Congress, the War Department, state water and power resources board, the Pittsburgh flood commission, the county planning commission, the city planning commission, the citizens committee on city plan, the Pittsburgh city council, the art commission of Pittsburgh, the public service commission of Pennsylvania, grand jury and court of quarter sessions, the plans are submitted to the county commissioners for approval. The county commissioners then refer the plans and specifications to the county controller whose engineer reviews the plans before the contract is finally advertised. Before the contract is awarded the proposed work must be advertised once a week for three consecutive weeks.

After the bids are opened a tabulation of the unit prices is compiled by the county engineering department in conjunction with the controller, and recommendation is made to the county commissioners by the Department of Public Works for the awarding of the work to the lowest responsible bidder, and after the same has been approved and the contractor has furnished the proper bond, actual work on the bridge is ready to start.

Joint Inland Freight Station Planned for Manhattan

New York Port Authority Proposes Nine Terminals on the Island Served by Trucks from Freight Yards in New Jersey

A MODIFICATION of the original plan prepared by the Port of New York Authority for moving freight between Manhattan Island and the trunk line railroads on the mainland in New Jersey has been adopted by the Port Authority. In its original plan, the "Comprehensive Plan for the Development of the Port of New York," the Port Authority called for 12 inland freight terminals on Manhattan Island and an underground "automatic electric" railway system in deep tunnels connecting them with the break-up yards in New Jersey. The present plan, which is presented as one step towards effectuating the comprehensive plan, calls for the construction of nine large freight stations on Manhattan Island to be served, pending the construction of the underground electric railway, by trucks operating between the freight terminals and the break-up yards in New Jersey, presumably by way of the Holland vehicular tunnel and the cross-river ferries, though the report does not even mention the means whereby the trucks are to cross the river.

Universal Inland Freight Station—For the purpose of this plan Manhattan Island below 57th St. has been divided into nine zones of equal freight density and large freight stations measuring roughly 600x200 ft. and providing 85,000 sq.ft. of freight-handling space and 1,600 lin.ft. of tailboard space for merchant trucks have been planned for each zone. Only the ground floor and basement of each building will be used for freight purposes; the upper floors will provide loft and warehousing space for lease to merchants and manufacturers, a provision made necessary by the high real estate values.

Freight for all railroads will be delivered to these freight stations by merchants in each zone and will be classified there and moved by trucks across the river. If it is found desirable, the system can be expanded to provide store-door delivery.

This plan applies to all freight except fresh fruit and vegetables and dairy products and freight now received at and dispatched from the team tracks in the Manhattan in-shore yards of the Baltimore & Ohio, Lehigh Valley, Erie and Pennsylvania railroads in the 23rd St. North River district and to the tracks of the New York Central R.R. above 30th St. Fresh fruits and vegetables will be handled through a union carfloat terminal located on the Hudson River, and dairy freight will be handled through a separate inland terminal to be provided somewhere on the lower west side of the island.

The plan calls for the abandonment of the tracks of the New York Central R.R. along the west side of Manhattan Island below 30th St. and approves of the removal from the surface of the tracks above 30th St., as outlined in a plan prepared by the borough president of Manhattan.

Freight To and From Manhattan—At the present time there are moved in and out of the Manhattan pier stations by carfloat approximately 830,000 cars annually. To accommodate this large volume of traffic 24 piers on the Hudson River, 17 on the East River, and 2 on the Harlem River are devoted to railroad uses.

Benefits of the Proposed Plan—Aecording to the Port Authority's statement, this proposed plan will produce the following benefits: Reduce cartage costs more than $12,000,000 annually through a reduction of cross hauling and the elimination of long-distance hauls and delays; will save the railroad companies more than $2,000,000 through the more expeditious handling of freight and the elimination of the major part of the carfloat transfer service in the harbor; will release 43 piers on the Manhattan waterfront for steamship uses and a large portion of the New Jersey waterfront now used for the marshalling and storage of cars for the carfloat service; will aid in the solution of the New York City traffic problem by reducing congestion of vehicles on the streets; and by providing modern food receiving terminals will reduce the food marketing cost.

High Curb for Bridge Traffic Protection

In the design of the Haverhill Lower bridge, at Haverhill, Mass., now under construction, protection of vehicle traffic against running off the bridge was given special consideration in view of an accident on the Springfield, Mass., bridge last year. As reported recently by Robert R. Evans, county engineer of Essex County, the Haverhill bridge has been designed with a high curb, this being chiefly depended upon for safety. In addition, the posts of the balustrade will be strongly anchored. He states that, in his opinion, "it is out of the question to design a fence or balustrade which would be certain to reduce the shock from a motor truck which might be moving at some speed," and that safety must be sought by providing a curb as high as possible, to prevent motor vehicles from climbing upon the sidewalk. On the Haverhill bridge the curb is 10 in. high, which was considered to be as high as the convenience of pedestrians would permit. While anchors for the balustrade had already been provided, the balustrade will be made still more secure by anchoring the balustrade posts, 8 or 9 ft. apart, by a threaded 1-in. bolt through them to an anchor above the post.

Viaduct Is Built of Reinforced Concrete and Encased Steel

Roosevelt Road Viaduct Built in Two Parallel Sections—Forms Hung Across Tracks —Continuous Concrete Girders

A VIADUCT 118 ft. wide built in two longitudinal portions, one of which is of reinforced concrete and the other of structural steel with concrete casing, is the unusual type of structure now being completed at Chicago in the improvement of Roosevelt Road (formerly 12th St.). This viaduct extends from

FIG. 1—BUILDING CONCRETE HALF OF VIADUCT
Form for roadway slab in middle and for massive girders on each side, flanked by sidewalk slab at left and slab for one car track at right. Old steel viaduct at right.

Wabash Ave. west to the Chicago River, 2,100 ft., beyond which it joins the viaduct now being constructed by the Chicago Union Station Co. from the river to Canal St., about 400 ft. In this latter viaduct both the north and south portions are of structural steel cased in concrete. The new structure on the east carries Roosevelt Road over a complicated layout of railway terminals, freight yards and main tracks, and also across the Chicago River.

A viaduct composed of steel truss and girder spans adapted to the track spacing was built in 1886, with a total width of 60 ft., the street width being 66 ft. It had two 18-ft. roadways and a double-track car line, and had a 220-ft. swing span at the river. With the growth of the city this street became a very congested thoroughfare, so that in 1911 it was decided to widen it to 118 ft. and to rebuild the viaduct to the new width, giving two 29½-ft. roadways, two 17-ft. sidewalks and a 25-ft. central space for the exclusive use of street cars. For the convenience of traffic, the viaduct was to be built in two longitudinal sections, and Fig. 1 shows the construction work on the south portion, which is of reinforced concrete. At the right is the old steel truss structure, with the swing span over the river. The elevation of the new viaduct at the river is considerably higher than that of the old structure.

In 1914, the city council passed a contract ordinance which constituted an agreement with the several railroads for the construction of the new viaduct, the railroads to pay $791,350 of the cost and the city the

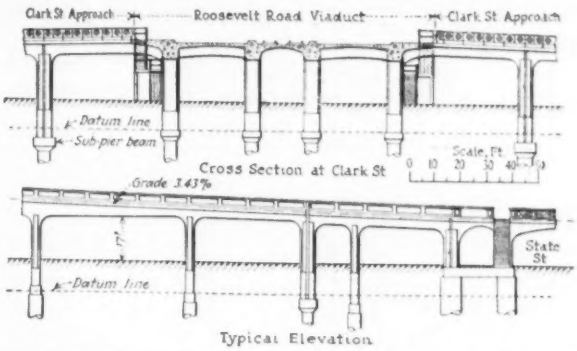


FIG. 2—TYPICAL DESIGN OF ROOSEVELT ROAD VIADUCT
Left-hand half of cross-section is concrete. Right-hand half is structural steel cased in concrete.

balance. When plans had been prepared and it was proposed to start construction the World War had opened and it was impossible to obtain structural steel owing to the war priorities. Studies were then made on reinforced-concrete designs. Since no change in track locations was permissible it was necessary to adhere to the span lengths and clearances specified in the ordinance plans as laid out for the steel design, requiring spans of 20 to 80 ft. It was evident that there was not room enough to design the structure as a series of single spans between columns, and the design adopted was for a continuous structure, considering the columns in the analysis. Furthermore, the span arrangement was so irregular that the ordinary coefficients for moments and shears could not be applied, so resort was had to the method of analysis known as the "slope deflection" method.

The complete south half of the viaduct east of the river, except across State St., was built to this design, shown in Fig. 2. Each bent consists of two rectangular columns carrying continuous longitudinal girders connected at intervals of about 20 ft. by cross struts. Upon the girders and struts is the deck slab, which is extended on each side as a cantilever; the south canti-

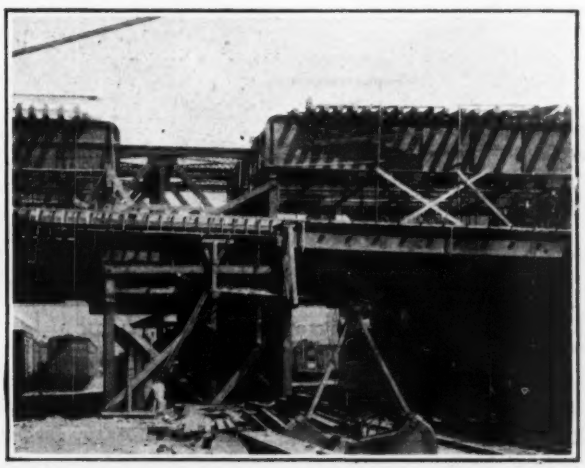


FIG. 3—PLATE GIRDERS CARRY FORMS OVER TRACK

lever extension forms the sidewalk and the north cantilever slab carries one car track. The roadway slab is 13 in. thick, increased to 19 in. at the expansion joints by tapering sections.

Across State St. a flat reinforced-concrete arch was built, with separate sidewalk spans and with stairways connecting with the State St. sidewalks. At Clark St., however, the street is raised by long viaduct approaches on a grade of 2.7 per cent, so as to cross the Roosevelt Road viaduct at grade (Fig. 2). All foundations are concrete cylinder piers sunk to solid rock and capped with concrete girders which support the columns of the viaduct. The live-load assumed included 50-ton street cars, 24-ton trucks and a distributed load of 100 lb. per square foot.

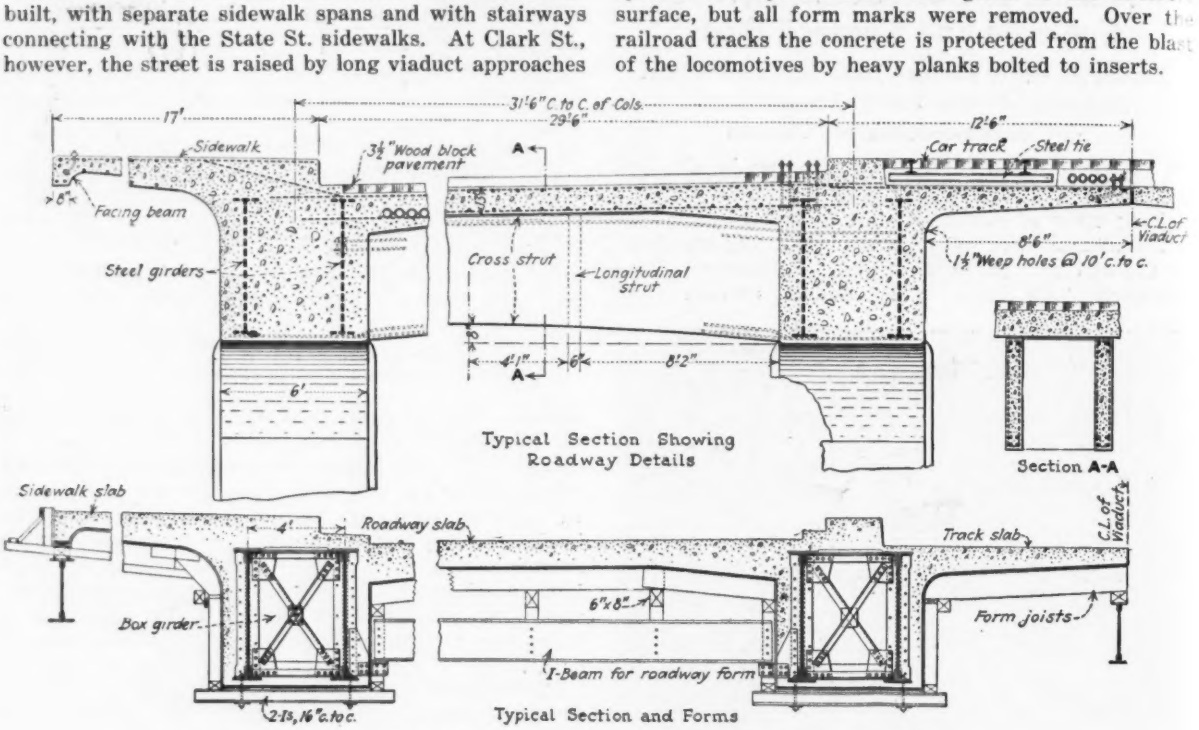


FIG. 4—HALF CROSS-SECTION OF VIADUCT, WITH STEEL GIRDERS

To carry the formwork over the tracks, where it was impossible to place falsework, old steel girders were erected on timber piers and from these the girder forms were suspended, as shown in Fig. 3. Concrete was mainly spouted into place, four timber towers being built to carry the cables of the main lines of spouts. No special finish was given to the concrete surface, but all form marks were removed. Over the railroad tracks the concrete is protected from the blast of the locomotives by heavy planks bolted to inserts.

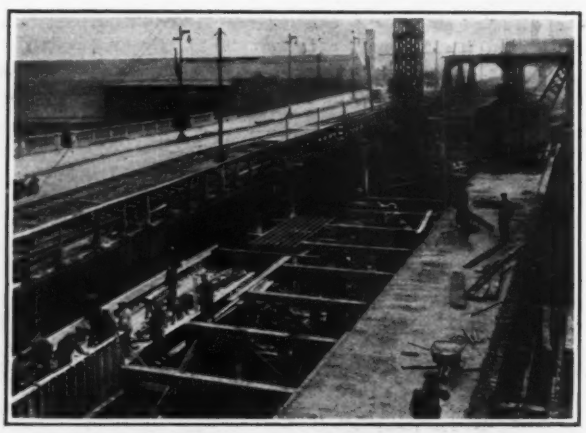


FIG. 5—STARTING NORTH SIDE OF VIADUCT
Completed south side at left, but with temporary street car tracks.

When the time came for the construction of the north half of the viaduct, structural steel was available at reasonable cost. Since steel construction for the main girders would simplify the formwork and its supports, a box girder was designed which could be enclosed in a concrete section the same size as the adjacent concrete girder, as shown in Fig. 4. These girders are connected by steel cross struts under the roadway slab. The forms for the concrete casing and the deck slab were supported from the permanent steel girders. Steel columns of H-section supporting these girders are cased in concrete, duplicating the appearance of the adjacent concrete columns. Fig. 5 shows the placing of falsework for the steel viaduct alongside the completed concrete viaduct, but the car tracks shown are temporary.

For some of the concreting of the deck and casing on the steel portion of the viaduct, the concrete was distributed by small dump cars. From a mixer at the ground level the concrete was hoisted high enough in a tower to be dumped into wooden 1-yd. gable-bottom cars on a narrow-gage track having stringers carried by timbers laid across the top chords of the old trusses. Trains of eight cars were hauled to and fro by a 5-ton gasoline locomotive.

The old swing span is still in use, but shifted laterally to the south portion of the new and wider viaduct and also raised to the higher elevation of the latter. This span will be replaced by a bascule bridge, probably a double-leaf span over the proposed straightened channel of the river.

In the old steel viaduct, the metal above the floor is in good condition, as are all the pins, but parts of the diagonals where they pass through the floor are

badly corroded and require frequent repairs in the way of applying hangers and additional diagonal rods. Portions of the bottom chord below the floor have been replaced and continuous repairs have been made in the last ten years to all of the floorbeams and stringers. These members would have been completely renewed but for the fact that the structure was to be replaced with a new viaduct. In some panels a new bottom chord was built above the floor, as described in *Engineering News-Record*, May 8, 1919, p. 212.

The plans for the Roosevelt Road viaduct were prepared in the bridge division of the Bureau of Engineering, Department of Public Works, under John Ericson, city engineer; Thomas G. Pihlfeldt is engineer of bridges, and Donald N. Becker, engineer of bridge design. All work was done by city forces of the construction division, in charge of J. J. Versluis, now engineer of water-works construction.

Massachusetts Building Its First Three-Strip Pavement

Reconstruction Job of 4-Mile Length Involves Laying of Two 10-Ft. Concrete Strips With Bituminous Center

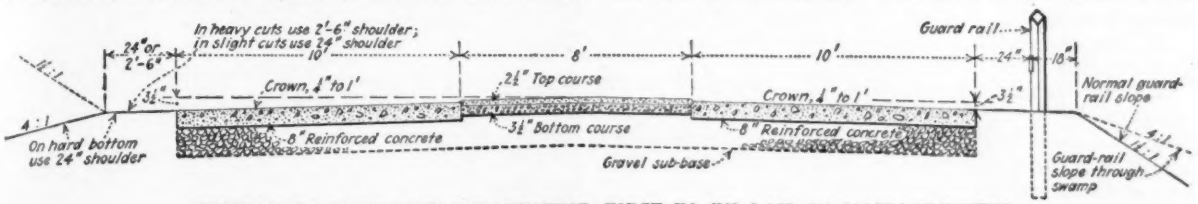
THE division of highways of the Massachusetts Department of Public Works is laying, between the towns of Canton and Stoughton, near Boston, the first three-strip pavement laid in that state. The job is one of reconstruction, the new highway replacing a 10-year-old bituminous macadam of insufficient width and inadequate base. The work is being done on the main highway from Boston to Newport, R. I., that passes through the towns of Taunton and Fall River. Along with the resurfacing and widening is being carried grade reduction, so that the maximum grade on the new road will be 5.6 per cent.

No attempt is being made to salvage the old bituminous macadam for base material for the new road. The specifications require that where the present hard surface is within 6 in. of the bottom of the proposed surfacing, it must be scarified and reshaped and left parallel with the bottom of the new surfacing, the existing bituminous macadam being excavated, if necessary to meet these conditions. Inasmuch as the grade reduction will call for considerable cut and fill, the old surfacing, where it is necessary to excavate it, will be used for fill where practicable. The four-mile job will involve about 26,000 cu.yd. of earth and 4,000 yd. of ledge excavation, and 10,000 yd. of ordinary borrow, the rest being gravel borrow.

The prevailing type of surfacing will be two side strips of reinforced concrete 10 ft. wide, with a center strip, 8 ft. wide, of bituminous macadam. Where the subgrade appears unstable so that concrete is liable to fracture, a full width of two-course bituminous macadam will be laid. Where the road is marshy, and settlement of fill is expected, one-course bituminous macadam will be put down, though in each case the wearing surface will be laid on a gravel sub-base ranging from 6 to 12 in. in depth. Where the black top is two-course work the top course is to be built of 2½ in. of broken stone penetrated with 2½ gal. of asphalt per sq.yd., and the bottom course of 3½ in. of broken stone bound with sand. There will be more than 2,000 lin.ft. of two-course top. One-course bituminous macadam will be of the same specification as the top course of two-course work. Of the one-course bituminous macadam for the full width of the highway there will be about 800 ft. The center strip where the pavement is three-strip will meet the specification for two-course pavement.

The concrete will be of a uniform thickness of 8 in. with transverse reinforcing rods spaced on 24-in. centers. Slab corners are also to be reinforced with deformed bars 6 ft. long buried 2 in. in the concrete and 3 in. from the slab edges. Expansion joints, in accordance with the standard specifications, are to be placed at intervals of not less than 60 ft. Slabs will be tied together with 4-ft. dowels.

Outside of the metalled surface shoulders of a minimum width of 2 ft. will be provided, giving an effective roadway width of 32 ft. The road section will be crowned with a camber of ¼ in. to the foot, and the center black top strip is to be raised above the concrete side strips three-eighths of an inch.



SECTION OF THREE-STRIP PAVEMENT, FIRST TO BE LAID IN MASSACHUSETTS

For concrete, and for the bottom course in two-course bituminous construction, local materials will be used largely. It is proposed to use imported trap-rock for the top course. The gravel base will be taken from roadside pits. Concreting will be carried on from both ends of the job, a 6-bag batch mixer and a 1-bag mixer being the equipment.

For the aggregate a screening plant will be installed at each end of the job, the combined capacity being adequate to the output of 400 cu.yd. of concrete daily. The crusher will be capable of crushing 200 tons daily of broken stone. Trucks with batch compartments will be used in materials haulage.

Though no concrete had been poured up to the middle of July, all concrete paving must be done by Sept. 15, and bituminous macadam laid by Oct. 15, so the entire job will be finished before cold weather sets in. The road will be closed during the reconstruction, traffic being detoured.

The work is being done under the direction of A. W. Dean, chief engineer, Massachusetts Division of Highways. Carlo Bianchi, Inc., of Framingham, Mass., is the contractor. The contract price is $268,000, or $67,000 per mile.

Studies in Concrete Memorial Tablet Construction

Best Mixtures—Letter Design—Letter Mold Coatings—Eliminating Form Marks—Resistance to Wear —Fabrication and Cost of Miami Conservancy District Tablets Recording Dam Construction

By J. K. Grannis
Schenck & Williams, Architects, Dayton, Ohio

THE Miami Conservancy District has constructed in the Miami Valley in southern Ohio an extensive system of flood control, among the primary elements of which are five large retarding basins properly located at strategic points within the drainage area. The dams which form these retarding basins extend across entire river valleys, and serve as control points for all discharges of water within the flood area. They are the most conspicuous single units of the whole project.

When this work had been entirely completed in 1922, it was found that these projects were objects of interest not only to the engineering fraternity but to the public at large. Thousands of tourists visited them each season and it became desirable to present to the public brief information regarding each dam. The minimum requirement was determined to be the posting for easy observation of the following data: (1) The name of the dam, (2) its purpose, (3) its dimensions and (4) when completed.

In considering how these data were to be presented to the public the following requirements presented themselves:

1. The permanence, dignity and simplicity of the project must be properly typified.
2. The outstanding engineering accomplishments should be properly recorded.
3. The construction must be permanent and withstand the attacks of weather and of vandalism, and eliminate maintenance and repair.
4. The tablets must be large enough and so executed and placed that they could be read by passing motorists without stopping, since, in season, an average of ten thousand visit these dams on Sunday, and in flood time as many as twenty-five thousand have passed in one day.
5. The officers of the District felt that the purposes of the tablets permitted only a modest expenditure.

These last two requirements were the final determining factors in the construction adopted. When constructed on the scale required for condition 4 the cost of executing them in bronze, granite or monolithic stone became prohibitive. The first and second conditions were accomplished in the careful design of the tablets with assistance of a competent architectural designer. The third, fourth and fifth were accomplished by the selection of cast stone or concrete.

Samples and Tests—It was intended to secure the services of an expert cast stone worker, but investigation developed that architectural finishing of cast stone was done when the surface was green, which means that the form or mold must be removed within a few hours, and the great weight involved made this difficult. If cast at a central point the cost of transporting and setting became prohibitive. The cost of setting up equipment for handling the green casts at five points each several miles distant was equally prohibitive. It became necessary, therefore, to permit the slabs to remain on the mold undisturbed until sufficiently seasoned to permit handling with a portable pole and rig. By this time the surface would obviously have seasoned so that any finishing would be superficial and would only result in crazing and flaking. No reliable data being available, a series of experiments was conducted to determine how a strong, dense, stainless face could be secured in the original cast.

Sample casts were first made using white Atlas stainless cement with proportions of white lake sand varying from 1:1 to 1:3. Each such mix was made of three consistencies—very plastic, stiff plastic and semi-dry (crumbly).

Similar test blocks were made using marble dust in lieu of sand. Others were made of white Atlas and brown river sand, of white sand and all common portland cement, of white sand, part white and part common portland, in varying proportions.

These samples were all made according to laboratory practice of measured parts, kneaded to uniform consistency, and kept out-of-doors under moist cloths for two weeks before removing form, and were seasoned for one week thereafter.

They were then inspected for general appearance, color, density of face and body and texture; then suspended and rung with an iron bar, in a series of overlapping succession, and the best selections laid aside. Samples were then tested for impact, scratching and tensile strength, and fractures inspected for density and general appearance. The mix of one part common portland and two parts white Atlas to six parts white was as strong as any other mix and gave the most uniform color and texture. The richer mixes showed crazing, the leaner mixes lacked density, and the greater parts of common portland gave irregular color effects or stains.

In every case the mixes of medium (stiff) plastic consistency were densest and strongest, but a drier mix was finally adopted owing to the influence of the letter pattern required for the incised lettering. Because of the large total of letters required, the cost of patterns was first considered. Since these were obliged to remain under and in the cast during the seasoning period, it did not seem safe to rely on using wood patterns more than once. Comparative prices were had for making five sets of wood or composition letters and for making one set of aluminum or brass letters. The cost being approximately the same, aluminum was selected, since it would be wholly free from distortion. These were used in all test blocks. The first were uncoated and could not be removed, after two weeks, without damaging the cast. This was due to pronounced adhesion between the cement and the metal.

Next they were dipped quickly in hot paraffin, resulting in a coating $\frac{1}{8}$ in. thick. This was found to be too thick a coat, resulting in a distorted cross-section. This coating also peeled off readily in applying the letters to the form. It was found that holding the

metal in the hot paraffin for a brief time resulted in heating the body of the metal so that a thinner coat adhered. This too was slightly fragile at sharp points

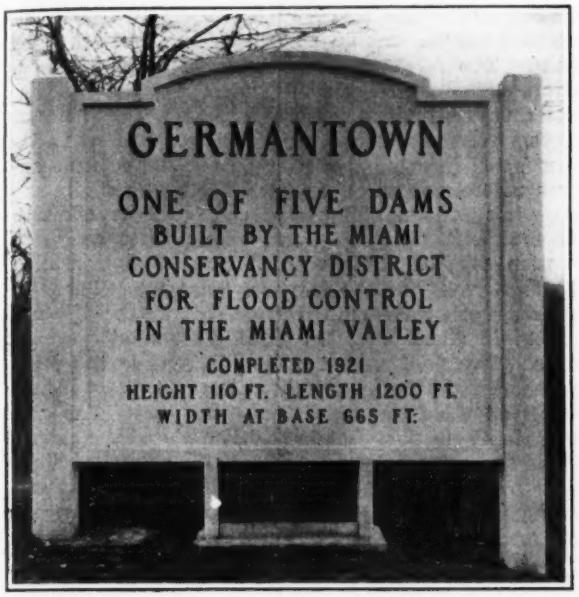


FIG. 1—APPEARANCE OF CAST CONCRETE TABLET

on the letters, and in addition the cement broke through the protective coating and formed adhesions. On stripping, the incised surfaces were found to be irregular and the letter outlines distorted.

Shellac was next tried but was found to encourage adhesion.

At this point it was proposed to increase the draft of the sides of the letters which were vertical for a distance in from the face. This developed the fact that these vertical faces were essential to produce a well defined shadow line, and that a slight increase in the draft of these sides reduced the legibility of the letters to a marked degree.

Investigation of sand blast cutting disclosed the same objection. The cross-section of the incision was moderately legible when the line of vision was normal to the face of the tablet, but legibility decreased rapidly as the line of vision departed from normal.

It then became necessary to proceed with the pattern letters and to develop some satisfactory surface for them.

Progressing from the experiments with paraffin, the letters were next dipped in hot beeswax and it was found that when left submerged for a brief period (10 to 20 seconds) they retained a thin coat which resisted the placing and setting of the mortar and permitted the free removal of the patterns without damage to either tablet or pattern.

Further casts made over these coated patterns determined that the medium plastic consistency which gave the best structural results did not give satisfactory finished surfaces for the incisions. The beeswax presented an impervious surface to which water clung without absorbing, and when stripped the surfaces were pitted and porous.

Moisture content of the mortar was reduced until a crumbling consistency was obtained, which, when sufficiently tamped, gave a highly satisfactory surface within the incision.

Another item for consideration was the surface of the form proper. The first casts were made on a form of jointed white pine, glued and battened, and coated with paraffin oil. The finished cast reproduced minutely the grain of the wood, and the glued joints were so distorted by the presence of moisture as to mark the surface. All methods which were successful in removing these marks involved the partial destruction of the dense face coating. Also, the paraffin oil reduced the absorption of the surface so that small globules of water were left to evaporate, which resulted in pitting. This occurred even with the crumbling mixture and since the flat surface lacked the drainage which the raised letter patterns had, it appeared that the form proper had to have some absorbent quality.

Final Lettering Plan—A heavy quality of shrunken muslin was stretched over the wood form. This had the proper absorbent quality and added to the uniformity of the finished surface, but in large sheets was found, when wetted, to stretch and buckle between the letters which were nailed through it. The resulting wrinkles were impressed in the face.

It was then found that a form of filled and prepared Decorators' Muslin similar to Sanitas, when applied with the muslin face to the cement gave the desired surface and absorption and possessed sufficient body to prevent distortion.

These several factors being determined, the execution was fairly simple. The muslin was applied to the form and the surface penciled in modules for placing the letters. The dipped letters were then applied, using

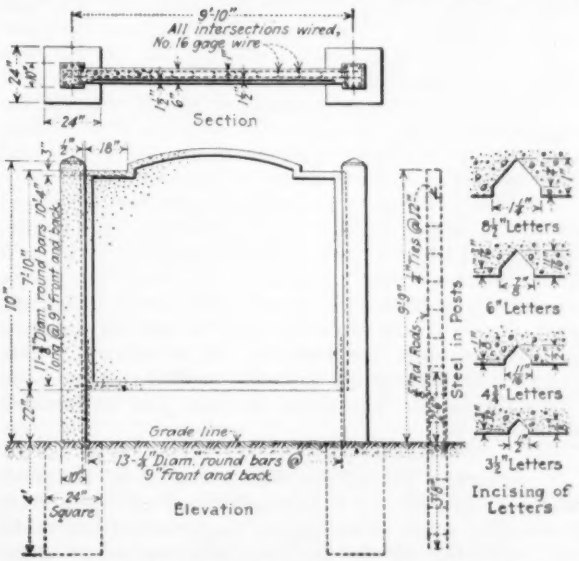


FIG. 2—DETAILS OF TABLET CONSTRUCTION

3d. common wire nails to secure them to the forms. The form was placed solidly and securely and level near the permanent tablet location. The mortar (crumbling plastic) was applied 2 in. deep by hand, placed around the letters with the fingers and tamped thoroughly with a wood mallet or gavel. This process was done as rapidly as possible, after which was added four inches of concrete of 1:1½:3 mix reinforced with ⅜-in. rods 6 in. c.c. each way. The whole was tamped thoroughly

and covered with four ply of wet burlap, which was kept wet continuously for two weeks. At the end of this time a gin pole and chain block were set up, heavy rope slings were placed around the slab and it was raised to a vertical position and braced. The forms were removed and moved on to the next site. Supporting columns extending well into the ground were then formed and poured around the edges of the tablet, forming a permanent and monolithic whole. After the surfaces were thoroughly air seasoned they were brushed with a stiff bristle brush, thoroughly saturated and a thin grout of white Atlas cement brushed lightly on. After about fifteen minutes, when this began to turn light, indicating partial evaporation, but *before initial set began*, the surface was rubbed briskly with excelsior to remove all cement not absorbed into the pores of the face.

This method was intended to form a natural integral filler for the pores which would reduce absorption and consequent frost action, and so avoid crazing common to brushed cement finish.

The results obtained appear to be wholly successful. The tablets were completed in November, 1923, and have been subjected to two winters and one summer season. No settlements or fractures due to external stresses are apparent. No shrinkage cracks or crazes are observed and the uniform resistance to temperature variation indicates comparative freedom from internal stresses. Minute crazing is observed in some of the supporting columns, probably due to the fact that the architectural design limited these to 10 in. square. Since they were to be supporting shafts rising twelve feet, they contained four ½-in. rods laced; and since they had to be cast monolithically, the lack of space in the form required a mortar free from coarse aggregate, and a wet plastic mix which would fill the form free from voids. There is no doubt that a leaner, coarser and drier mix would have given better structural qualities had the pouring space permitted. Particular note has been taken as to erosion from wind or frost but no trace of such has yet been observed.

The surfaces show no signs of weather stain and appear to be permanently and uniformly gray white. The incised lettering, with vertical draft part way back from the face, gives a satisfactory legibility except when the sun is shining directly into the incision. At such times, if the observer is also looking squarely into the incision, the legibility at a distance is less than required for quick and easy reading. It has been found necessary, therefore, to coat the background with black paint.

Construction Procedure—The execution of the work was economically done, particularly since there were five similar casts to be made. Organization had to be made allowing for the fact that only one set of metal letter forms was available, and casts could only be made successively. Organization also had to allow for the fact that the five dams were several miles from Dayton, and distant from each other from six to fifty miles.

The superintendent chosen was, in fact, a contractor of high intelligence who was genuinely interested in the technical results and in the costs. He devoted his entire time to the work and became also the chief mechanic, personally performing the delicate parts of the work, including dipping the patterns, placing the muslin face on the form, placing the metal patterns, placing the mortar with his hands, and wetting the casts daily. His only regular assistant was a skilled carpenter, and he employed two laborers for brief intervals to mix the coarse aggregate and to assist in hoisting and placing the casts.

The form was set up at the first site and the cast made. The form was then engaged for two weeks before the next cast could be made. In that time the materials were assembled at the second site; the supporting frame and form were built ready to set in the form panel carrying the letters; the column forms and laced reinforcing were prepared for the first site and the column footings excavated and cast. In addition, the first cast was visited and wetted twice daily and location selected for the third site. This consumed the two weeks for the two men engaged. When the lettered form was removed from the first cast it was hoisted in slings, and left until the second cast was made. Two days were required to remove the form, transport it to the second site, rearrange the wording, recoat all the letters, and make the cast. The men then placed the first cast in position, placed the column forms and reinforcement, and cast the columns. They then prepared the column forms, reinforcements and footings for the second cast, moved the bracing and form supports from the first site to the third, and prepared there for the reception of the lettered form, accumulated material at the fourth and fifth sites, and wetted the second cast twice daily.

It was intended that during these intervals the finishing of the surfaces would be carried on, but with each additional cast the average daily transportation cut down the actual working hours so that only a small portion of finishing was done until the last cast was made.

Cost—The estimated cost of the work was $5,000, and the actual cost was as follows:

	5 Tablets	Each	Per Cent Total
Engineering supervision and overhead	$476.86	$95.37	9.1
Labor (including superintendent)	2,530.67	506.13	48.3
Transportation (men and materials)	676.00	135.20	12.9
Materials (cement, aggregates, steel)	363.47	72.69	6.9
Aluminum forms for letters	825.00	165.00	15.7
Other supplies (lumber, bolts, etc.)	373.47	24.70	7.1
	$5,245.47	$1,049.09	100.0

These costs include all experimental work, which amounted to approximately $350. Transportation of men was 7,000 car-miles and the labor cost includes traveling time involved. These items were peculiar to this job but all other items of the cost would apply to any job.

All of the tablets have been subjected to minor vandalism, principally the impact of stones thrown by small boys. In a few instances small caliber rifles have been used. Neither has had any damaging effect.

In one instance a shotgun was discharged at close range and a faint abrasion occurred, but the uniform density of the mortar was such that the abrasion is not apparent except at close view and is not then disfiguring.

It appears that the observations made are conclusive, except as to erosion from weather, concerning which a much longer period for observation must be allowed.

The work appears to justify the hope of its designers that concrete can be successfully and economically employed as a substantial, permanent and pleasing architectural medium, but the results here obtained are

believed to depend not only on the thorough and careful consideration given to the selection of materials and methods, but in larger part to the extraordinary patience and accuracy of the workmen in executing the work.

The work was done under the general direction of Charles H. Paul, chief engineer of the Miami Conservancy District. The conception and design was by Schenck & Williams, architects, Dayton, Ohio. The experimental work was by Robert E. Schenck and J. K. Grannis of that office, and the work was executed under their supervision by H. H. Rupe.

Designing Banked Highway Curves for Safety

Curve Pavement Constructed in Two Strips, Each of Parabolic Section, Gives Varying Bank for Different Speeds

By C. J. Myers

Senior Assistant Engineer, Bureau of Highways, New York State, Utica, N. Y.

With a view to harmonizing the conflicting demands of high and low speed vehicles the following method is proposed for designing a cross-section for a banked curve:

The approximate formula $x = 720/r$, in which x equals the bank per foot of width in inches and r equals the radius of the curve in feet, will give perfect banking for a speed of 30 miles per hour. For any other speed the bank will vary directly as the square of the speed.

For extremely short-radius curves the perfect bank will be practically impossible to obtain. For a 60-ft. radius curve the formula gives a bank of 12 in. or the pavement is tipped up to an angle of 45 deg. It is apparent then that for ordinary use a limit must be set on the amount of bank per foot that will be used. The New York State Bureau of Highways' standard design calls for a bank of 1½ in. per foot for all curves of less than 300-ft. radius and this discussion assumes that this is the maximum rate needed.

What is the maximum bank which is safe and comfortable under all conditions for slow traffic?

I believe it is somewhere between ½ and ¾ in. per foot.

How much should each lane of traffic be widened on curves?

It should depend on the radius and for this discussion we will adopt the New York State standard of 6 ft. for all curves of less than 300-ft. radius for a two lane pavement 18 ft. wide.

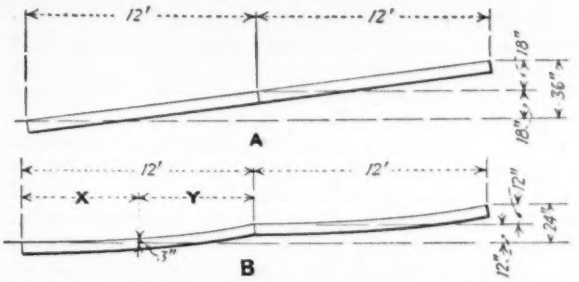
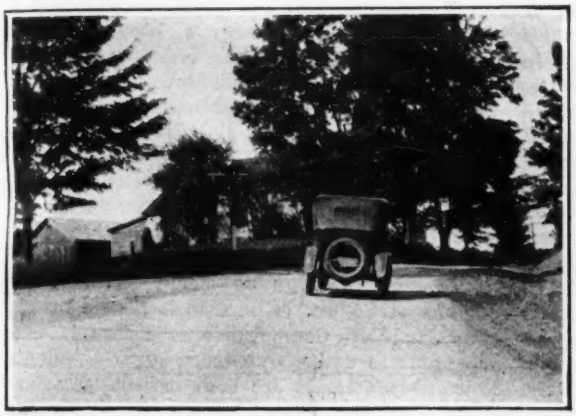


FIG. 1—STRAIGHT BANK AND DOUBLE PARABOLIC BANK

Assume that we wish to design a section for a two-lane pavement 18 ft. wide on a curve of 300-ft. radius. Substituting in the formula we find that x equals 2.4 in. per foot for 30 miles per hour. It is obvious that we should use the maximum bank of 1½ in. per foot which will give perfect banking for a speed of about 24 miles per hour but may be driven with safety at a much higher speed. The section will be like Fig. 1*A* and there will be times when the slow traffic will be uncomfortable and perhaps in danger.

Instead of making the total bank 36 in. as in Fig. 1*A*, suppose we make it 24 in. as in Fig. 1*B* and make each lane of parabolic section. The average bank will be reduced to 1 in. per foot but the bank which a vehicle may use will vary and will depend upon which part of the lane it is in. As the wheel tread of an ordinary car is about 5 ft. it will be possible for it to be entirely within width X which is 6 ft. and there its average bank will be 3 in. in 6 ft. or ½ in. per foot. If it moves over to Y, there its average bank will be 9 in. in 6 ft. or 1½ in. per foot. The same thing will be true of the other half of the pavement.

We have then designed a section on which, going in either direction, one can pick a path which will give him a bank of ½ in. per foot if going slow or of 1½ in. per foot if moving at high speed or he can use any bank he wishes between these limits. By this design we secure all the advantages of the heavy bank for speed and have a perfectly safe section for heavy loads and slow speeds. It also has the advantage of cutting down the difference in elevation of the two sides of the



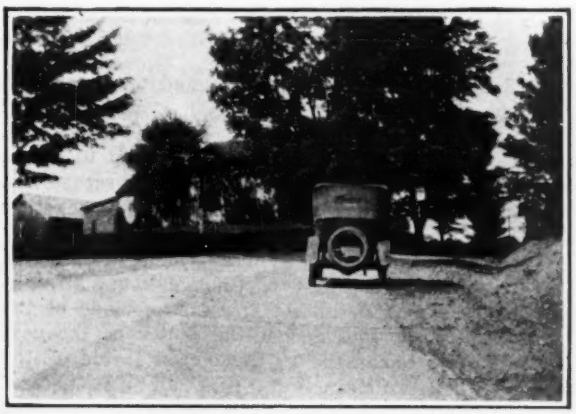


FIG. 2—BANK VARIES WITH LOCATION OF CAR
Left—Car on bank of 1½ in. per foot. Right—Car on bank of ½ in. per foot.

pavement by one-third, which in some cases saves considerable excavation and helps on the drainage. The slight angle in the pavement where the two slabs meet at the center merely accentuates the center line and helps to keep traffic on its own side.

One should keep in mind that there is no intention to provide more than two lanes for traffic on curves and that in general traffic follows about the center of each slab where the bank is 1 in. per foot only leaving this path when moving either slower or faster than the quite wide range of speed at which the center can be driven comfortably.

It is probably impracticable to use this design except for concrete pavement or where concrete base is used. So far as known it must be built one lane at a time.

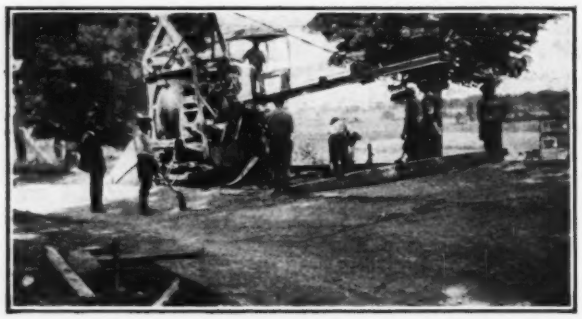


FIG. 3—SCREEDING SECOND HALF ON DOUBLE PARABOLIC BANK

No difficulty in construction was found on a concrete pavement recently built. A straight crown was used on the tangent sections and the same straight screed was used on the approach to the curve up to where the bank was about ½ in. per foot. Then a screed was made of three 2x10-in. plank 14 ft. long bolted together after being cut to the proper curves. Two screeding faces were provided, one with a middle ordinate of 2 in., the other of 4 in. in 14 ft. Change from a straight screed to the flattest curved screed was made at the center of a 40-ft. slab and at the center of the next slab a change was made to the opposite side of the screed. A little skillful use of a float ran these surfaces together smoothly. Little or no more work on finishing a concrete pavement on this section is necessary than finishing with a straight crown.

So far as the writer knows only two curves have been built on this design and while they have been used but little as yet they seem to have all the advantages expected (Fig. 3). The parabolic section can be used on any width of lane from 9 ft. up with advantage and only one double-edged screed is needed. Design the screed for the greatest width of curve that is to be used and use the same screed on the narrower sections. I believe a straight bank should be used on all curves calling for a bank of ¾ in. per foot or less, for all curves of shorter radius an average bank of 1 in. should be used and the section should be made parabolic. Based on a speed of 30 miles per hour that would mean all curves less than 960 ft. have a parabolic section.

If a greater maximum bank than 1½ in. per foot is needed it is only necessary to remember that on the basis of a 12-ft. width of lane, one-half the lane will have approximately ⅓ the average bank while the other half of the lane will have 1½ times the average.

If we assume that the slow traffic will be safe on a path with an average bank of ¾ in. per foot then an average bank of 1½ in. could be used and the maximum bank would be 2¼ in. per foot average for the steepest half of the 12-ft. width.

Some Bridge Fires in Texas

SIX bridge fires in Texas are noted in "Texas Highway Bulletin" of July, 1925, by G. G. Wickline, state bridge engineer. Five of these involved wooden structures or steel structures with wooden floors, while the other was the case of a 70-ft. steel span with reinforced-concrete trestle approaches, which was badly damaged by the burning of oil in the dry river bed. This bridge was located in Limestone County, between Mexia and Groesbeck, and had been completed only about two months when the Mexia oil fields were developed. Oil wasted by the drilling operations accumulated in the dry river bed and formed a pool 2 in. deep under the bridge, which later was set on fire by some boys for sport. The heat of the flames, which leaped 50 ft. high, damaged the lower chord of the span and caused large slabs of concrete to flake off the sides of the piers, which were made with local coarse limestone aggregate. This accident occurred in 1920; repair cost $3,500, which was paid by the oil companies.

The wooden bridge and bridge floor fires included the following: Rio Grande bridge at Laredo, September, 1920, five steel spans of 180 ft. with creosoted timber floor just replaced. The fire probably was caused by a cigarette stub. A brisk north wind blew the flames and in less than an hour the flooring was destroyed and two spans collapsed while the others were practically ruined by the heat. The bridge was replaced by a reinforced-concrete arch structure. (2) Creosoted timber bridge 400 ft. long near Talco, Titus County, destroyed in 1922. (3) Timber trestle near Chilton, Falls County, 450 ft. long, destroyed Feb. 26, 1925. (4) Timber approaches and flooring of steel spans over East Navidad River near Schulenburg, Lavaca County, destroyed March, 1925. As the bridge was old, it is being replaced by a new structure. (5) Timber trestle bridge near McNary, Hudspeth County, destroyed May 4, 1925.

Division engineers and maintenance superintendents of the highway department are under standing orders to exercise unusual precautions in removing accumulations of trash and growth of weeds and grass from around timber bridges. Such maintenance work in the fall and winters is believed to have saved many bridges.

Electrification Study on Maine Central

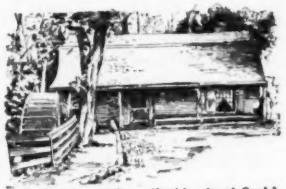
A study of the economic possibilities of electrification on the two principal lines of the Maine Central R.R. between Portland and Bangor, through Lewiston and Augusta, 140 and 135 miles respectively, is to be made by Murray & Flood, consulting engineers, New York. This project includes the new Rigby freight yard at South Portland and the yards at Portland, Bangor and Waterville. Experience with rail-motor cars has not been satisfactory, according to the company's annual report. A gasoline motor car with seats for 38 people was withdrawn from one run for lack of patronage and although continued on the Bangor and Bucksport branch, 19½ miles, its limited capacity and power necessitates the substitution of steam train at times and in winter. Study is being made of an oil-electric locomotive, now in the development stage.

Engineering in the Small City

A series of notes from the field on the Problems and Practices of the Municipal Engineer in the Cities Below 100,000

The Editor Visits the City Engineer

Snapshots of Our Representative Small Cities



OLD WINTHROP MILL, NEW LONDON, CONN.

New London, Conn.

ONE OF THE COUNTY SEATS OF NEW LONDON COUNTY, 13 miles south of Norwick, the other county seat, and 51 miles east of New Haven. Situated on the Thames River, 3 miles from its entrance into Long Island Sound. Has excellent harbor and steamship communication to New York. New London was formerly the seat of extensive whaling and sealing interests. Manufacturing now is extensively carried on; there are silk mills, brass and copper tube works, oil-engine works, ship yards, foundries and machine shops, cotton-gin factories, bed-quilt mills, printing-press works. Schools are the Connecticut College for Women and the School for Instruction for the U. S. Revenue Cutter Service. The annual Yale-Harvard boat race is rowed on the Thames River. Several historic buildings are preserved in the town. City was founded in 1646 by John Winthrop, the younger, and until 1658 was known as Nameaug; on the latter date received its present name. Incorporated in 1784. Pop. 1920, 26,999.

IN THE charter of the city of New London, Conn., which gave to the city the council-manager form of government in 1921, there is found the following extract: "The division of engineering and water-works shall be in charge of a competent engineer to be known as the city engineer. He shall be appointed by the city manager and . . . shall have charge of all engineering work, all public buildings, the water and sewer system, the ferry and wharf property and such other things and matters under the department of public works as may be designated by the city manager." Insignificant and indefinite as the words appear, "and such other things and matters" have invested George E. Watters, city engineer, with certain duties the diversity of which is rarely matched. When you venture the opinion that he must have his hands full, Mr. Watters has this positive reply: "Gee, but I like it." And if you follow him about for a day into every corner of the city, or sit with him at his desk and listen to the ease with which he dispatches problems carried there by troubled property owners, you are convinced that he does like his job tremendously.

Doing Many Things Efficiently—The council-manager form of government was adopted in 1921. Under the administration of former city manager James E. Barlow, the details of the new form of government had been thoroughly established. When the present incumbent, William A. Holt, was made city manager late in 1923 he found Mr. Watters in charge of engineering work. Since Mr. Watters had been with the city water and sewer departments for more than a score of years, and since his offce had all of the engineering equipment, it seemed fitting to Mr. Holt that he should invest the city engineer with direct control over all engineering work. Aside from the fact Mr. Watters exercises direct control over design and construction of water, sidewalk and sewer installations, bridges, public buildings, supervises all public property including the city's ferry and pier, through the superintendent of streets he is in direct control of maintenance of streets, garbage and ash collection, and parks and street lighting. Add to these duties supervision and planning of construction, for the city does most of its own work by force account, and you have a fair picture of the wide field Mr. Watters' duties cover. And there is not a detail in the administration of his various jobs with which he is not thoroughly familiar.

The visitor to Mr. Watters' office is struck at once with the businesslike appearance of the office itself. Mr. Watters' office is not buried where small city engineering offices are so often found—on the third floor, rear. It faces the principal street, is on the second floor and is near that of the city manager, a clerical staff occupying the room that separates the two. His is the office of the busy administrator, not the repository for engineering antiques. On one wall are two framed blueprints, one a plan of sewer lines and the other of water services. On the opposite wall are two other prints, one of the watershed of the city-owned supply, and the other a U. S. G. S. quadrangle map with the watershed spotted upon it. Furniture includes Mr. Watters' desk, a small consultation table, a steel filing cabinet and a steel bookcase. There are no endless rolls of dust-inviting blueprints, grade stakes, odds and ends of engineering equipment cluttering his office. All the physical perquisites of his office are kept in the drafting room across the hall where his three assistants busy themselves.

New London has no particular engineering problems imposed by its topography or distance from source of construction materials. It lies along the Thames River and rises to the hills back of the river. Frontage on the river is about five miles and the width of the corporate limits varies from a scant half-mile to little more than a mile. The highest point in the city is about 255 ft. Sewage disposal therefore resolves itself into a mere matter of placing outfalls far enough into the river so that the current and the tides will carry the sewage into Long Island Sound, thus avoiding deposition of decaying matter along the river bank. When a new outfall is required detailed flow studies are made at the proposed outfall location. These flow studies were described in *Engineering News-Record* July 30, p. 170, in a separate article

Water Engineering—Water for the city comes from Lake Konomoc, a 600-m.g. storage supply about six miles from the city, with auxiliary reservoirs of 212 m.g. and 160 m.g., each, located 9 and 11 miles from the city. The city owns all but two small parcels of land within the watersheds and maintains a superintendent on the premises to see that no contamination of the supply is possible. Raw water is of such a quality that chlorination is the only treatment given it. The supply is a gravity one, though pumping is done to a small reservoir within the city limits to equalize the pressure.

The fact that the city lies above ledge rock along the Thames gives to the city engineer his biggest difficulties. In sewer and water main installations, that ledge rock, with its overburden of gravel and sand,

makes trenching a tedious and at times dangerous procedure. As caving is always a possibility tight sheeting is quite often necessary. A trencher was found impracticable because of the impossibility of carrying sheeting along as fast as the trenching, so trenching for any installation is a tedious manual job. This has been one of the principal reasons for the city's doing such work by force account. Another reason is that there are numerous odd jobs to be done and Mr. Watters finds it advantageous to keep an average force of about 30 men at work, though that number is doubled during the construction season. Just what such a force of men can be kept busy at is best understood by studying a progress chart hanging in Mr. Watters' office. These are the jobs listed: water and sewer mains, hydrants, sidewalks, curbing, new fence around a schoolhouse, reflooring of municipal pier, painting and hanging of street signs, repair of fence on watershed, work at the chlorine plants, new flume for the town mill, beach toilets, traffic signal device at one of the fire stations, etc.

Construction of a new flume for the town mill is of interest. It is the old mill, presumed to have been erected in the middle of the seventeenth century, used by John Winthrop, first governor of Connecticut. The mill and its huge overshot wheel are both in excellent condition and are of great interest to tourists. Mr. Watters is going to put in a new flume so that the wheel will turn at fifteen-minute intervals, there being not enough water in the pond to keep it turning all of the time.

An unusual responsibility which Mr. Watters has is the supervision of construction of all school buildings. Few city engineers have anything to do with such work, it being usually the responsibility of the board of education and private or public architects. New London is now building a grade school, design of which was selected from a number of competitive bids. Though the architect maintains constant inspection the responsibility for adequacy of construction lies with Mr. Watters.

Sewer Construction—Since trenching gives New London its greatest construction difficulty, it is not amiss to explain the practice of that city in preparing for sewer installations. The first step lies with the property owners, who make application for the installation of the sewer. That application is presented to the city manager who, with a letter of transmittal, turns it over to the city council in the form of a resolution authorizing the making of plans and estimates and city manager's report. Resolutions are then passed by the Council on said report. The city clerk then sends to each property owner a notice of a proposed meeting of the board of compensation, which body fixes the per capita cost on the basis of the estimate made by the city engineer. Local newspapers carry three successive advertisements of the meeting of the compensation board. The compensation board then meets and the property owners are given an opportunity to be heard. The compensation board then makes its report to the council. The board is made up of two city officers and one other man. The city engineer is a member of that board now. The report of the board is explicit as to the course of the sewer and the pro rata cost of the improvement. The council then draws up an ordinance and a certain date after its passage construction starts.

Engineering Work

Prior to construction the proposal to build must be advertised for four successive weeks. Notice that construction has been authorized is also sent each of the property owners, to be benefited, within ten days of the passage of the ordinance.

Sidewalks—Practically the same procedure follows in the case of sidewalk construction. There is an alternative, however, in each of these cases, and that is offered in case the property owners wish immediate construction. They then sign the petition and waive the hearing upon the cost of the improvement and other details. This saves both cost of advertising and weeks of time.

New London has practically standardized upon one-course sidewalks of the following specifications: 7 in. of crushed stone or cinder base, 4 in. of 1:3:6 concrete, and 1 in. of a 1:1 cement finish. Expansion joints are placed at 5-ft. intervals. Where much sidewalk construction is to be undertaken the work is let by contract, for the price this year has been such that there would be no advantage in the city doing the work. So far sidewalks of the above specifications have cost the city 27 cents a square foot.

Indexing Engineering Maps and Data

THE following is an abstract of a talk given by Henry A. Varney, town engineer of Brookline, Mass., before the Boston Society of Civil Engineers. It is believed few better systems of indexing and filing engineering data exist than that which is found at Brookline.

The system of indexing now in use in the engineering department of the town of Brookline was devised in the year 1902, after considerable study of the methods used in several of the larger municipal engineering offices in New England.

Everything is indexed under the name of the nearest street and also cross indexed under every other street referred to in any way. Plans, notes and documents are indexed separately and at present there is a fourth index for "Land Plans," which, however, can be combined with the main plan index at any time.

Standard sized flat plans are always used when feasible and are filed in shallow drawers and numbered consecutively in addition to the designations explained below. Not more than fifty plans are ever filed in one drawer. When large plans cannot be avoided, they are rolled and filed in pigeon-holes or plan tubes.

"Land Plans" are copies of plans recorded in the Norfolk Registry of Deeds relating to property in Brookline. They are made on tracing cloth and are always filed flat.

Drawers are lettered and numbered, the letter referring to the bank or section of drawers, and the number to the position of the drawer in the section. It might possibly be better to number the drawers consecutively and so do away with the section letter, as plans are sometimes put away in the wrong section by mistake and so lost for an indefinite period, and again, it makes one more designation to remember when looking for a plan.

White cards of medium weight are used in indexing, about 3 in. by 5 in. in size, with tabs to designate the different classes of work. No colored cards are used except for guides and sub-guides, the former being buff and the latter blue. The tabs are of such size as to allow space for twelve classifications. For the plan and note index ten are used at present, as follows: map, street, sewer, drain, park, building, bridge, land plan, water and miscellaneous. By the use of these tabs it is possible to locate the required card very easily.

Of the Small City

On plan index cards the street name is written across the top, then below this at the left is a space for the filing numbers, and at the right, room for a description of the plan and still lower down are ruled places for the date, scale, engineer and material. Only one reference can be put on these cards.

For the land plan index the street name is placed in the upper left-hand corner, and the side of the street on which the property is located, at the right. The next line below is for the names of the streets between which the property shown is located, and the lower part of the card is divided into vertical columns for the owner's name, engineer, scale, date and place of filing.

In connection with the plan index a "Drawer" book and "Accession" book are used.

The drawer book is for the purpose of showing what spaces are available in drawer or pigeon-holes for plans about to be filed. Two pages are reserved for a drawer and are headed with the section and drawer number. Down the left side of each page are the numbers 1 to 50, with an additional column for the accession number, and to the right of that column a space for a brief title.

The accession book gives all the information relating to a plan and enables it to be located if the index card is misplaced or lost. In this book are recorded the full title, scale, date, size and material of each plan under an individual or "accession" number; also the initials of the assistant by whom the survey was made and plotted, the purpose for which it was made, and where and under what streets it was filed. Every plan made by the department is given an accession number whether it is to remain in the office or is for record.

In indexing notes they are arranged under subjects in addition to the tab classification. Calculations, estimates, levels, profiles and surveys are some of the "subjects," about twenty being used. This classification is written in the upper left-hand corner of the card, the opposite side being reserved for the street name. Below are vertical columns for the date, book and page and a brief description. The vertical ruling makes it possible to put several references relating to the same subject and street on a card, thereby reducing the number of cards in the index.

The loose-leaf system has been adopted for street line and grade work and for sewer construction, and this has cut down the growth of the note index, as the loose leaves are filed in the same manner as cards behind the proper street name and do not have to be indexed. If the loose-leaf idea was applied to all classes of notes, calculations, estimates, etc., it would eliminate the necessity of a note index except, of course, for the old books.

The document index is for all correspondence, reports, estimates, bids, descriptions, specifications, etc. Everything is indexed under the name of the street to which it refers, as in the plan and note index, and, in addition, the correspondence is indexed under the person's name from whom the letter is received or to whom it is written. These latter cards are filed in a separate drawer. The tab card system is used here also, the tabs referring to the above-mentioned subjects. The cards are further classified by the use of sub-guides cut in "sevenths" and labeled "street," "sewer," "drain," "park," "water," "bridge" and "miscellaneous." If the document to be filed was a description of a street location it would be indexed on a "description" tab card and placed in the index behind the sub-guide "street."

The documents are filed by the vertical system, in legal size folders numbered consecutively. No more than fifty sheets are allowed in a folder and each paper is stamped with the number of the folder as well as an individual number. This enables one to locate any document exactly and if any are missing there is no chance for speculation as to whether such a document was ever filed there.

The number of plans in the department has more than doubled since the index was started, but any required plan is as quickly and easily found as at first, in fact, the system, throughout, has proven very satisfactory and capable of indefinite expansion.

Graphical Control of Application of Oils and Asphalt

By M. D. Knight
Principal Assistant Engineer, Department of Public Works, Lynchburg, Va.

Contractors and engineers are often required to use an asphalt distributer of new type and find difficulty in teaching green men to apply road oils and asphalts of various consistencies at the specified rates. Such was the case recently when a homemade distributer was put into operation. This machine was built of an 800-gal. tank mounted on a 3-ton truck. Pressure was maintained at the supply pipe by a standard asphalt pump driven by a Ford engine. It was found that with the engine controlled by a governor a uniform pressure could be secured. So the engineer equipped his truck with a speedometer geared up to register low speeds accurately.

The truck operated at various speeds and the gallons per square yard were computed in each case. This relation was graphically shown by plotting the curve with co-ordinates of truck speed and gallons per square yard. The engineer had expected this to be a straight line but simple analysis shows it to be a hyperbola:

Let R be the rate of application in gallons per square yard.
S be the speed of distributer in miles per hour.
C be the capacity of distributer in gallons.
T be the time of emptying in fractions of hour.
D be the distance covered in yards.
W be the width covered in yards.
A be the area covered in square yards.

Now: $D = 1760TS$

$A = DW = 1760TSW$

$$R = \frac{C}{A} = \frac{C}{1760\,TSW}$$

Since C, T, and W are constants and R and S the variables, the equation of their loci becomes,

$$RS = \frac{C}{1760\,TW} \quad \text{or } K$$

Of course, where the speedometer is not regular equipment but geared up it would be a simple matter to introduce the proper differential; and by actual test with a minimum number of trials, the time of emptying can be determined for any fluid at the normal temperatures and pressures. Where several different rates are desired or different materials are being handled by the same machine a chart should be prepared and placed where it would be convenient to the operator. The constants having once been determined would remain the same regardless of the width of roadway, since with a constant pressure, the removal of nozzles would proportionately cut down the flow.

It is believed that this method of control far surpasses that observed two years ago on New York State highway work where the engineer drove stakes to mark the distance a full distributer should go. The operator attempting to reach without passing these points maintained a fair average though the uniformity of application is doubted. It is admitted that speedometer control is more practical in the handling of lighter oils used for surface treatments than in the handling of asphalts in which the temperature becomes an important factor. At the same time each case would have to meet its own conditions and charts facilitate uniform application.

Endurance, High-Heat Strength, and Long Loading Tests

Abstracts of Papers Read Before the American Society for Testing Materials—Endurance Under Axial Stress Found to Agree with Flexural Endurance—Flow of Metals Under Maintained Loading

High Temperature and Long-Time Tests of Metals

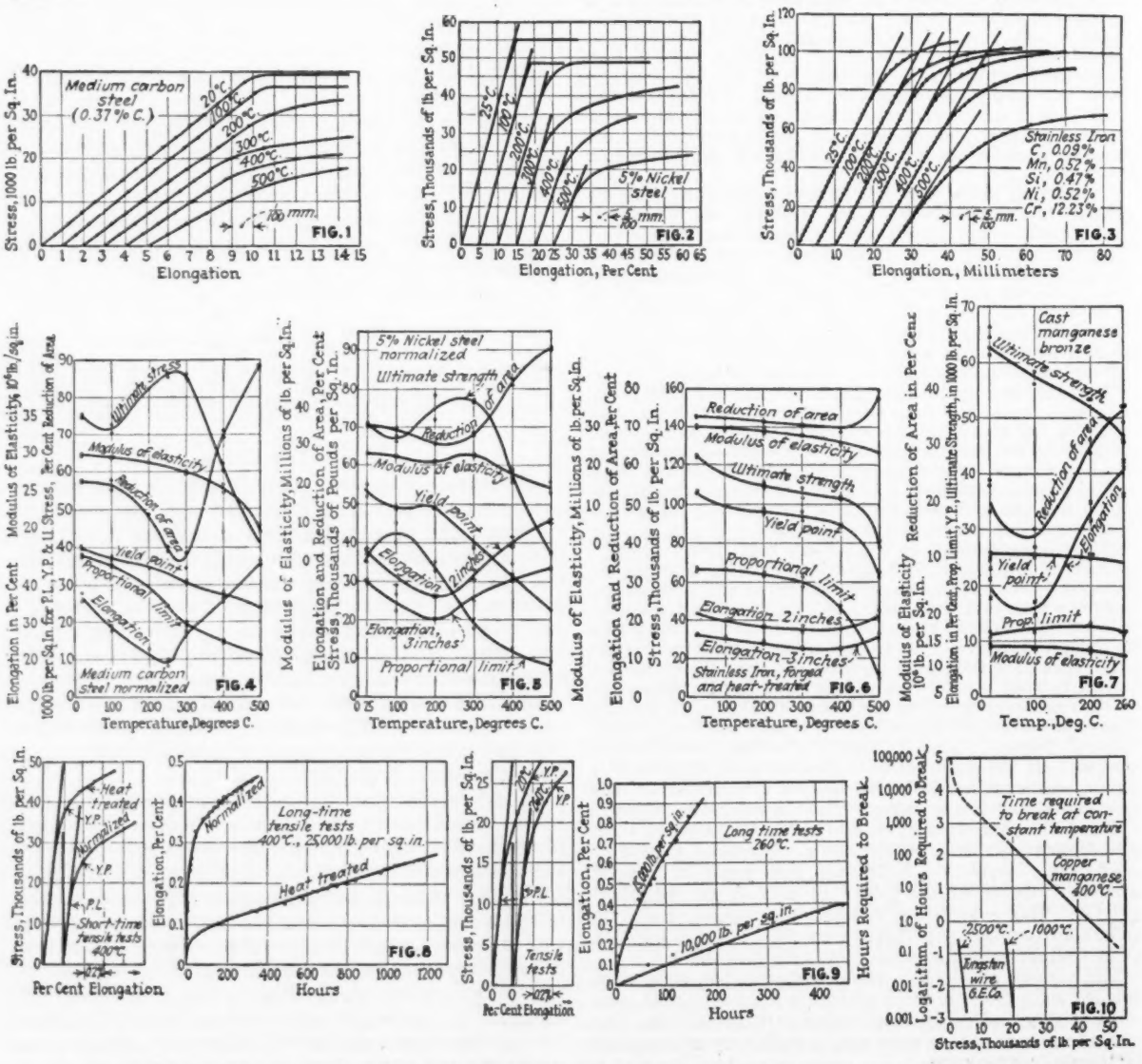
By T. D. Lynch, N. L. Mochel and P. G. McVetty
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

A HYDRAULIC type of tensile testing machine of 100,000 lb. capacity was used in making a series of tests on short-time strength, in which the effects of temperature alone were determined. The resistance type of furnace has been found to give a very satisfactory method of heating since the spacing of the turns can be so arranged that the temperature is made uniform over the entire gage length.

Figs. 1 to 3 show typical stress-strain diagrams, in which the effect of temperature on the proportional limits is apparent.

Fig. 4 shows the effects of temperature upon the tensile properties of a medium carbon steel in normalized condition; similar curves were found for the same material as rolled, and heat-treated. Proportional limit and modulus of elasticity are reduced with increase of temperature. The strength decreases to about 100 deg. C. and then increases to a maximum at about 275 deg. C. The ductility as measured by the elongation and reduction of area decreases in general up to about 250 deg. C. and then increases with increasing temperature. Fig. 5 shows similar data for a 5 per cent nickel steel in normalized condition. The variation of properties with temperature is somewhat similar to that shown for medium carbon steel; the ductility is considerably higher, especially at its minimum value near 250 deg. C.

Fig. 6 shows similar data for stainless iron. This material is affected in a less degree by high temperature than



EFFECT OF HIGH TEMPERATURES AND LONG-TIME LOADING ON TENSILE PROPERTIES OF METALS

any of the other materials examined. The elastic properties as measured by the proportional limit and modulus of elasticity decrease less than 10 per cent between 25 and 300 deg. C. The ductility, as measured by the reduction of area, decreases less than 5 per cent between 25 and 400 deg. C. The ultimate strength at 500 deg. C. is about twice that of the carbon and nickel steels at the same temperature.

Considerable work has also been done on non-ferrous metals, of which cast manganese bronze is an example. Fig. 7 shows its tensile properties over the temperature range of 20 to 260 deg. C. The elastic properties appear to be only slightly affected through this range of temperature, but ultimate strength shows considerable reduction.

Long-Time Loading—The tests in which the effects of continued stress at high temperatures were determined required special equipment. The test piece was suspended from a steel frame through a ball-and-socket joint and carried at the lower end a similar ball-and-socket joint which supported a yoke carrying a knife-edge. A lever pivoted to the frame at one end, bearing on this knife-edge, could be loaded at the free end to give the desired stress.

Several tests were made on medium carbon steel at 400 deg. C. and at various stresses. Fig. 8 shows the effect of a stress of 25,000 lb. per sq.in. at a temperature of 400 deg. C. Short-time tensile test curves are shown for reference. The stress chosen for the comparative long time tests represents the yield-point of the normalized material, and the proportional limit of the heat-treated material. The former material shows continued extension over a period of more than 14 days, and the other shows no tendency to stop stretching within a period of 50 days. Further tests on normalized material at 400 deg. C. and 14,000 lb. per sq.in. (7 per cent below the proportional limit at 400 deg. C.) showed a rate of stretch rapid at first but becoming zero after about 150 hours. This test was later prolonged over 900 hours without evidence of further stretching.

While the results so far obtained will require further confirmation, it is apparent that a stress corresponding to or slightly lower than the proportional limit can be carried by this material indefinitely without causing continued extension.

Fig. 9 shows long-time test curves for manganese bronze at 260 deg. C. and stresses of 10,000 and 15,000 lb. per sq.in. These stresses are 10 per cent below and 30 per cent above the proportional limit respectively. It is evident that there is no tendency for stretch to stop in either case. Tests on other non-ferrous metals seem to confirm these data in that they show no tendency to cease stretching at high temperatures, even when stressed considerably below the proportional limit.

Temperature control must necessarily be very close if creep phenomena are to be accurately determined. The curves obtained in these tests indicate that the temperature variation was within 1 deg. C.

It is also of interest to study the phenomena of stretching when the stresses are considerably over the proportional limit. Such stresses produce fracture if the test is sufficiently prolonged. If the stress on successive test bars is reduced, the time to cause fracture is more than proportionally increased. Plotting the stress in pounds per square inch against the *logarithm of the time* to cause fracture gives a straight-line relation, as shown in Fig. 10 for copper manganese. In the same figure are also plotted certain results obtained by other investigators on tungsten wire. The curve must tend rapidly upward toward the left as shown by the dotted line and must be asymptotic to the critical stress value. For non-ferrous metals this critical stress value appears to be very small or it may not exist.

* * *

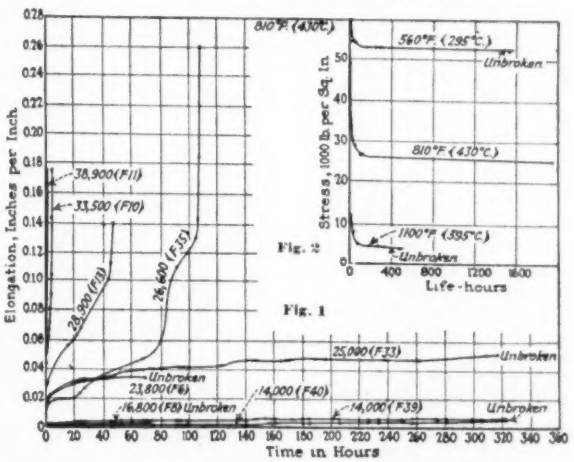
High-Temperature Flow of Steel (discussion by H. J. FRENCH, U. S. Bureau of Standards)—During the past year the writer and some of his associates have studied the creep or flow of a low-carbon steel at various temperatures. In addition to the customary short-time tensile tests, the flow was followed in 0.25 per cent carbon steel when subjected to fixed applied loads at room temperature, 560 deg. F. (blue heat), 810 deg. and 1,110 deg. The time for which the loads were maintained varied with the conditions and the purpose of each test but extended up to 1,800 hours.

The total flow producing fracture when low-carbon steel is subjected to a fixed total load in tension at approximately constant temperature takes place in three distinct steps (Fig. 1), the importance of which varies with the applied load and temperature: (1) An initial flow; (2) a secondary flow at fairly constant rate, which is also considerably less than the rate during the first and third periods; (3) a final rapid flow just before fracture.

As the constant applied load is increased, the initial flow and the rate of flow in the second period increase and the life of the steel decreases. The final rapid flow begins when the reduction in cross-section accompanying appreciable elongation has raised the unit stress to a definite value at each temperature.

The relation between decrease in applied load and increase in life is approximately hyperbolic.

At atmospheric temperatures, there is a small difference in the loads permitting very long life and loads producing fracture in a few moments. As the temperature is raised,



HIGH-TEMPERATURE TESTS OF FLOW OF STEEL

the increase in life with decrease in applied load becomes more gradual. An important effect of temperature increase is to reduce strain-hardening ability of the steel. This is a maximum at ordinary temperatures and decreases until it becomes zero in the neighborhood of 750 to 800 deg. F. (400 to 525 deg. C.). As a result, the principal factor governing the maximum allowable stress varies with temperature and the type of service. When both long life and freedom from appreciable deformation are required, the maximum allowable load closely approximates the proportional limit. These limite were found to approximate closely the maximum allowable stress values successfully used by an engineer for the design of commercial equipment operating at high temperatures. In the range 70 to about 600 deg. F. (20 to 350 deg. C.) higher working stresses can be used if appreciable deformation can be taken care of and long life is the primary requirement.

* * *

High-Temperature Static and Fatigue Tests of Steel

BY PROF. T. MCLEAN JASPER
Assistant Professor of Engineering Materials, University of Illinois, Urbana, Ill.

THE metals in general use at elevated temperatures are almost all ferrous, and consist in the main of wrought steel, cast steel and cast iron. It is gradually becoming known that certain ferrous alloys are capable of withstanding stress at high temperatures better than others. Such metals are usually high in tungsten, nickel, chromium, or some satisfactory combination of those alloys. Fig. 1 gives a general idea of the relative values of steels containing these alloys when tensile strength at elevated temperatures is considered. These data are from annealed steels and cast iron, and are largely drawn from results by Harper and MacPherran. The results of tests on steels at elevated temperatures show that in general the static properties other than strength are affected by temperature in the following manner: The higher the strength for any particular steel, the lower the percentages of reduction of

area and elongation and the higher the hardness factors.

The method usually adopted in testing metals at ordinary temperatures has been to make a test which lasts less than ten minutes, and expect this to represent the strength and ductility factors to which the metal will conform when subjected to stress for months, or even years. For wrought and cast ferrous metals at ordinary atmospheric temperatures, this assumption may be made without serious error, but at elevated temperatures an error of from thirty to fifty per cent depending on the temperature used may result when this procedure is followed. Static testing at elevated temperatures, therefore, is not so simple, nor can it be as expeditiously carried out as at ordinary atmospheric temperatures.

As the temperature is increased the metal gradually loses certain of its elastic properties and at the same time assumes a state approaching that of a plastic amorphous material. As this condition is approached, the steel tends to continually increase its stretch or strain without an accompanying increase of load, and the result is that the long-time tensile strength varies from the short-time tensile strength in an increasing percentage as the temperature is increased. The effect of this is well illustrated in Fig. 2, which shows the variation of the static properties of a quenched metal and indicates the values of the tensile strength at elevated temperatures under ordinary test conditions and under long-time test conditions. In the short-time test the material was continuously loaded to its tensile strength within a period of about five minutes after it was raised to the correct temperature. The values of the tensile strengths in this case are shown by the upper tensile strength curve. In the long-time test, the specimen was tested to its proportional limit fairly rapidly and then increments of load were added only when strain or stretch had become zero, or almost so, for each increment of load. In this manner, the time necessary to break a long-time test

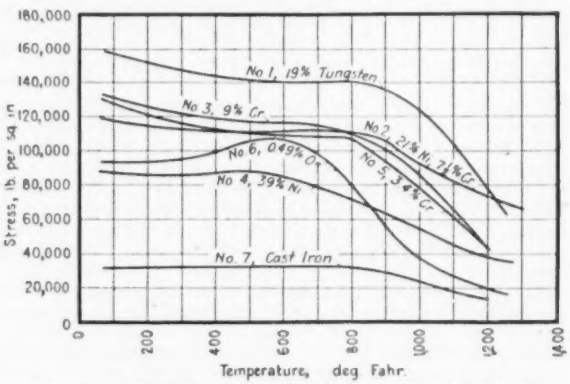


FIG. 1—HIGH-TEMPERATURE TENSILE STRENGTH OF ALLOY STEELS AND CAST IRON

specimen varied from 12 to 72 hours, depending on the material and on the temperature at which it was being tested. The values of the long-time tensile strengths are shown by the lower portion of the tensile strength curve. It will be noticed that, as the values of the temperature of specimens are increased, the ductility values are also increased and the strength values are decreased. It should also be pointed out that the endurance limit curve goes above the long-time tensile strength curve as the temperature is increased. An explanation for this is given below.

A curious effect obtained in the testing of annealed or normalized steel is shown by the fact that, as the temperature approaches the neighborhood of the so-called blueing heat, the tensile strength is increased. Fig. 3 shows the static values obtained for this steel, and it is suggested that this state of high stress is largely due to the temperature and stress conditions prevailing during the test, and is closely allied to the effect of mechanical working which it receives during the process of the test. The proportional limit is not increased as the temperature is increased, showing that the mechanical working has its greatest static effect during the yielding of the material at these blueing temperatures. In connection with this strengthening effect at these particular temperatures a few tests were made in

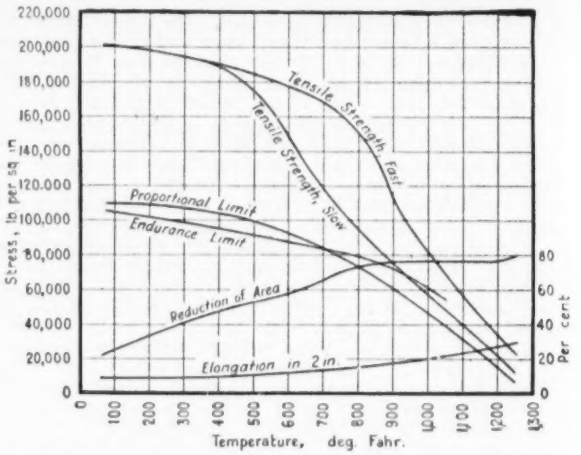


FIG. 2—STRENGTHS OF HIGH CARBON STEEL TESTED RAPIDLY AND SLOWLY

which the metal was stressed to 90 per cent of the short-time tensile strength, then allowed to cool, and retested at ordinary temperatures. The results are indicated in Fig. 3 by the crosses at ordinary temperatures, and show that the effect of mechanical working is very appreciable and is retained when the metal is reduced to ordinary temperatures.

In order to demonstrate whether or not the strength of this steel could be obtained by heat treatment as well as by mechanical treatment at the blueing temperature, the best heat treatment, as found by previous tests in the Fatigue of Metals Laboratory, was used for a series of static specimens. This metal was quenched and drawn at 400 deg. F. The upper dotted lines in Fig. 3 show the static tensile strength of this metal at various temperatures and indicate that if a steel is heat-treated so as to develop its greatest strength at ordinary temperatures there is no hump in the strength curves at elevated temperatures, as is shown for the steel in the annealed or normalized state. It also shows that the tensile strength at the blueing temperatures of the heat-treated specimen is no greater than for the specimens that were normalized before testing. This shows that there is no advantage obtained in tensile strength by heat-treatment if the metal is to be used at or above the blueing temperature.

The dotted line in Fig. 3 next below the tensile strength line represents the proportional limit of the heat-treated steel at various temperatures, and is much higher than the proportional limit curve for the normalized steel. This bears out a previous statement to the effect that the strengthening effect on the normalized steel at the blueing temperature, due to mechanical working, comes after the yielding of the material, and is associated with the stress and temperature conditions during the approach of the test specimen to the tensile strength of the material. Retesting specimens at ordinary temperatures after they had been stressed to 90 per cent of the tensile strength and then cooled, shows that the proportional limit is raised by mechanical working at the blueing temperature for all specimens after the initial stressing has been performed under such conditions. It is suggested that the reason for the foregoing phenomenon is that the blueing temperature of a wrought ferrous metal gives the best conditions for working a metal to obtain the maximum strength by mechanical means. That this strength can be made to approach that obtained by the best heat treatment, is indicated by those tests.

Fatigue strength results on steels at elevated temperatures, while essentially long-time tests, may be expected to exhibit phenomena somewhat different from that shown by long-time static tests. It has been shown that for temperatures above from 400 to 600 deg. F. the static test results vary with the rate at which the specimens are stressed. The specimens used in obtaining the fatigue results at elevated temperatures shown in Figs. 2 and 3 have been stressed from maximum to minimum at the rate of 1,500 cycles every minute, and this is probably comparable to the

short-time static test rather than the long-time static test. It will be noticed in Figs. 2 and 3 that at high testing temperatures the fatigue endurance limits approach in one case the long-time static tensile strength, and in the other case exceed this value. It is expected that, as the rate of stress repetition is decreased in fatigue tests, the endurance limit found at elevated temperatures will also decrease, because a longer time will be available per cycle at the slower speeds for the yielding of the material, and the long and short-time effect will prevail in a manner similar to that shown in static tests.

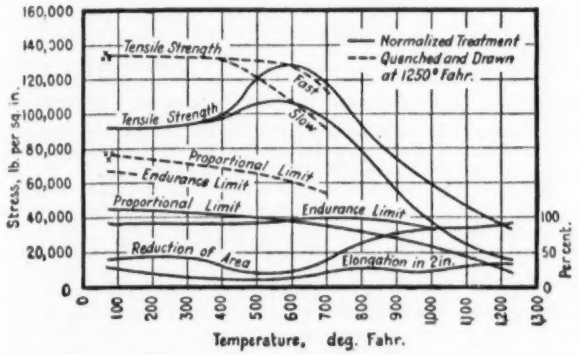


FIG. 3—STATIC AND FATIGUE PROPERTIES OF 0.50 PER CENT CARBON STEEL

* * *

Fatigue of Metals by Direct Stress

BY PAUL B. IRWIN
Research Department, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

VERY few data are available on the endurance limits of steels for unequal tensile and compressive stresses. For such a study it is necessary to utilize machines in which the stress is directly applied. This at once leads to the difficulty of obtaining a purely axial load. The present paper refers to a certain development in equipment which is the result of an effort to obtain a purely axial load in this form of test, obtaining data on endurance limits.

Description of Machine—The machine used for obtaining the endurance limits in direct stress was that designed by B. P. Haigh and made by Bruntons. In this machine the test specimen is subjected to a tensile and compressive stress alternating at 2,000 cycles per minute. The upper end of the test specimen is held stationary while the lower end is threaded into a cross-head. This cross-head is constrained to move in an axial direction relative to the test piece. The motive power is supplied by an armature which is attached to the cross-head and which moves through a small air gap between two fixed magnets. The machine was supplied with threaded bushings in the head and cross-head into which the test specimen could be screwed. It is evident that the center line of the head, the axis of the specimen and the line of motion of the cross-head must all lie in the same straight line if the test specimen is to be subjected to an axial load. Preliminary tests with a Marten's extensometer showed that due to the grips being non-adjustable, considerable bending stresses could occur in the test specimen. Alignment seats and test-piece grips were designed to correct this condition.

Test Specimen for Direct Stress—In this type of machine the total range of load is 2,700 lb. A specimen subjected to equal tensile and compressive stresses is impressed with a load of half this value, or 1,350 lb. For small loads, certain discrepancies occur in the magnetic characteristics and it is necessary to work on the upper two-thirds of the load scale in order to obtain reliable results. This makes it necessary to have different sizes of test specimens in order to test materials varying widely in endurance limit values.

It was furthermore thought desirable to change the design of the test specimen in order to facilitate assembly, avoiding any stress concentration on the central portion and still retaining a certain amount or rigidity in order to withstand the compressive loads. In order to fulfill these requirements the original type of specimen, with threaded ends and reduced section, was modified to that shown in Fig. 1. The test specimen between the heads is formed by swinging the cutting tool on a 7⅞-in. radius. Fracture always occurs in the central section of the specimen, although the stress is not concentrated.

The diameter at the minimum section was varied for different materials as follows:

Material	Minimum Diameter, in.	Area, sq. in.
Low-carbon steel	0.226	0.040
Medium-carbon steel	0.196	0.030
Chrome-nickel steel	0.160	0.020
Manganese bronze	0.253	0.050
Cast iron	0.253	0.050

In the new arrangement, ball-and socket alignment seats were embodied to allow freedom of the test piece from bending stresses. Having assumed an unstrained position, the balls are locked against the seats by a half turn of a nut.

On account of the difficulty encountered in the insertion of a threaded test specimen and the consequent probability of overstrain of same, the button-head type of test piece was designed in conjunction with the grips which are screwed permanently into the ball joints. A few turns of a nut lock the button heads in the grips. These grips lock the test specimen against vibration, give a self-centering fastening to ensure concentricity between ball joint and axis of test specimen, give rapidity in insertion of test specimen and prevent lateral deflection of the specimen.

The degree of perfection of the alignment obtained may be estimated by examination of the fractured test specimen. If, for example, a low-carbon steel be subjected to a stress which will cause fracture to occur at approximately 100,000 cycles, there will, at failure (a circuit breaker controlled by a 6-volt relay actuated by a switch on the moving armature could be so adjusted that the machine was stopped when partial fracture had occurred), be a noticeable extension of the specimen in the region of minimum cross-section. The cracked test specimen on being rolled upon a surface plate is observed to roll true, thus showing that, through the use of the new grips, no bending stresses have been acting—otherwise the cracked specimen would have become bent.

For the cases examined (low-carbon, medium-carbon and chrome-nickel steels) the curves obtained by plotting stress against number of cycles to fracture were very regular, the points all lying on a smooth curve.

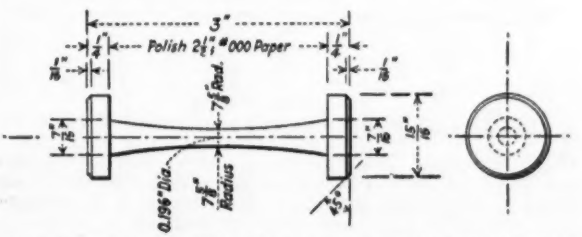


FIG. 1—TEST SPECIMEN FOR DIRECT STRESS ENDURANCE

Results of Tests—A variety of materials were tested. Their tensile properties are given in Table I. It will be noted that these properties vary over a fairly wide range.

In Table II are given the endurance limits obtained for these various materials in direct stress. For the purpose of comparison, fatigue tests were made on the same material under cycles of flexural stress. These endurance limits are also given in Table II. The third column of the table gives the ratio of the endurance limit under direct stress to the endurance limit under flexural stress and shows this ratio to be approximately unity.

The fourth column gives the ratio of endurance limit to strength in tension—the steels agreeing closely in this respect. It will be observed that in this ratio the non-ferrous metal varies markedly from the ferrous.

From these considerations, it is concluded that a satisfactory attachment has been designed, for direct stress testing, which makes possible the speedy insertion of test specimens and their removal without injury to the surface

TABLE I—TENSILE PROPERTIES OF VARIOUS METALS

Material	Prop. Limit lb. per sq. in.	Yield Points lb. per sq. in.	Tensile Strength lb per. sq. in.	Elongation in 2 in., per cent	Reduction of Area per cent
0.15-per-cent carbon steel (annealed)	30,087	32,000	49,400	41.0	69.1
0.37-per-cent carbon steel (annealed)	39,000	42,000	80,500	28.1	42.0
0.68 per-cent chromium, 2.93-per-cent nickel steel	100,000	113,000	133,700	18.4	49.7
0.84-per-cent chromium, 3.33-per-cent nickel steel	92,000	97,000	119,000	24.5	59.4
Manganese bronze	32,500	79,500	105,500	8.0	17.0

TABLE II—ENDURANCE LIMITS OF METALS OF TABLE I

Material	Endurance Limits—Direct Stress, lb. per sq in.	Endurance Limits—Flexural Stress, lb. per sq.in.	Ratios—Direct Flexural	Ratios—Direct Tensil Strengt
0.15-per-cent carbon steel (annealed)	24,500	25,500	0.96	0.50
0.37-per-cent carbon steel (annealed)	33,000	30,000	1.10	0.41
0.68-per-cent chromium, 2.93-per-cent nickel steel	56,200	55,000	1.02	0.42
0.84-per-cent chromium, 3.33-per-cent nickel steel	58,200	61,500	0.95	0.49
Forged manganese bronze	17,500	16,000	1.09	0.17

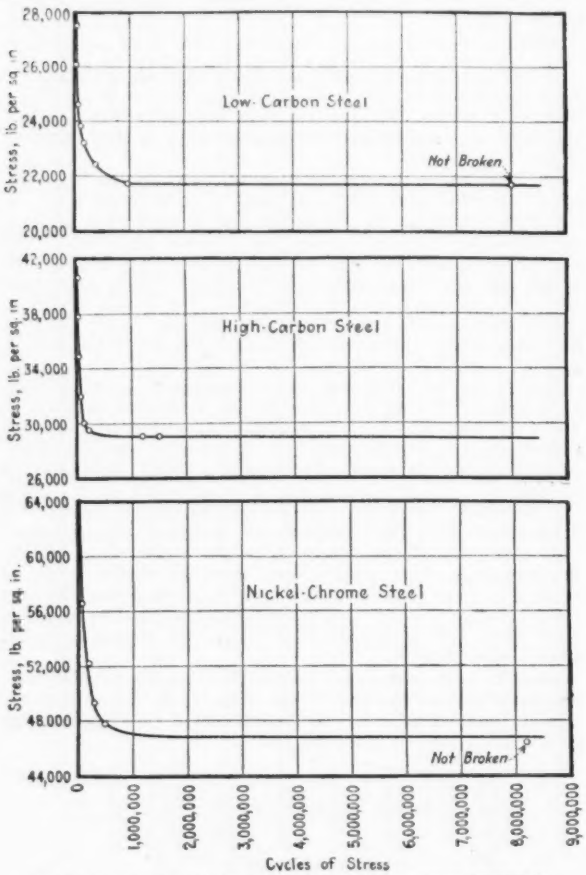


FIG. 2—ENDURANCE CURVES FOR THREE STEELS

of the fracture. Furthermore, a new method of calibration has been devised in conjunction with a new design of high-speed extensometer which gives accuracy in calibration and which may have other applications.

A result of more importance to the designer, however, lies in the comparative data which show (for all cases examined) that the endurance limit obtained by direct stress is the same as that obtained by flexural stress.

* * *

Axial Stress Endurance in Practice (Discussion by H. F. MOORE)—Mr. Irwin's paper gave some very significant test results, which seem to bear out his conclusion that the endurance limit for a metal is practically the same for reversals of axial stress (tension-compression) as it is for reversals of flexural stress. This does not agree with some previously obtained test results from other laboratories, but probably the difference is due to the great care used by Mr. Irwin in obtaining axial stress on his specimen. Other experimenters, including the writer, have not taken such thorough precautions. It is very difficult indeed to get pure axial stress on a short specimen.

One conclusion which may be drawn is that the inexpensive rotating-beam fatigue testing machines give reliable results for endurance limits. Ten rotating-beam machines can be purchased for the price of one machine such as Mr. Irwin used. The tension compression machine has a field of usefulness in connection with certain research problems, but for the general determination of endurance limits Mr. Irwin's tests seem to show the reliability of the rotating-beam machine and to answer certain recent criticisms.

In connection with the difference between Mr. Irwin's results and those obtained by earlier experimenters with tension-compression machines, it might be noted that these early experimenters secured as even a distribution of stress in their specimens as is secured in machine parts subjected to repeated axial load—such parts as piston rods and connecting rods. The difficulty of getting uniform stress distribution in a short tension or compression member has not been appreciated either by testing engineers or by machine designers. The actual maximum stress on a piston rod is usually distinctly greater than the value obtained by dividing the load by area of cross-section. Under static load this excess stress is small, but under repeated stress, such as in the service of a piston rod, this excess stress is important because it may start a fatigue crack. In designing members to resist repeated axial stress, it seems necessary to allow a factor for stress intensification, which, in some cases, may be as high as 1.30 or 1.40.

Los Angeles Architects Combine For Public Service

Have Association Which Plans and Constructs Public Buildings at Regular Fees for Common Profit of Profession

BY S. P. TROOD
Allied Architects Association, Los Angeles, Calif.

CO-OPERATIVE professional service to the community is being developed to a high degree in Los Angeles by the Allied Architects Association of that city. Since 1921, when it was founded, the association, comprising now 70 practicing architects of southern California, has undertaken many important commissions for the designing and supervision of construction of important public buildings and public works, among which may be mentioned the designing of a $9,000,000 county museum, the Los Angeles Patriotic Hall, the exterior and lobbies of the new Los Angeles Hall of Justice, and the proposed Los Angeles Civic Center. It is now engaged in the design of a new $5,000,000 county hospital. The methods of operation of the association may best be understood, perhaps, by a description of the way this last work is being carried out.

While the contract was awarded to the association several months ago, the county had not then chosen the exact site for the proposed structure. However, upon receiving the contract, the body immediately undertook an exhaustive survey of the hospitalization needs of the county. A special commission comprising members and officials of the Allied Architects held a series of conferences with members of the county hospital medical staff and of the County Board of Supervisors that they might discover the most suitable size and type of building. Material aid in this work was furnished in the early stages by two noted hospitalization experts. By the time the county had determined the actual site of the new building, the association had sufficient pertinent data on hand to serve as a basis

for the architectural planning, and the beginning had been made. All available information which had been secured through the two surveys was placed before the membership of the body and the members were requested to prepare designs, setting forth their individual conceptions as to the proper solution of the problem at hand.

In response to this request more than twenty sketches were presented at the first general meeting of the Allied Architects Association held for consideration of the hospital planning. Each sketch was carefully studied, discussed, and criticized by the gathering as a whole, while members of the Board of Supervisors and of the present hospital medical staff expressed their own opinions as to the merits and demerits of the various sketches. This general meeting was the first of a series of similar conferences through which the plans believed to be inadequate were gradually eliminated. At last but three remained, and these were turned over to a special jury on design for still further consideration. Under the supervision of this jury, these sketches were combined into one general plan, known as the final preliminary plan.

With the completion of this work, three representatives of the Allied Architects Association, Edwin Bergstrom, president, Myron Hunt, and Sumner Hunt, vice-presidents, set forth from Los Angeles upon a tour of the more important hospitals of the East and the Middle West to study the new improvements and innovations of hospital architectural planning with a view to their incorporation in the county structure. Accompanying the architects on their study-tour were J. J. Bean, of the Los Angeles County Board of Supervisors, and Dr. N. N. Wood, chief of the county hospital medical staff. On their return members of the association were apprised of the information which had been obtained, and were again requested to submit new studies of the problem, using the additional data gained as a basis. This was carried out, and at the next general meeting seventeen sketches were presented. As at all the meetings, these seventeen plans were thoroughly discussed, criticised, and studied, with the result that nine were selected for further development. These nine sketches are now under the consideration of a new jury of design, appointed by the board of directors of the association, and the best points of each plan will be incorporated into the final design.

Method of Paying Fee—In all this architectural work the association serves on exactly the same footing as an individual architectural firm. The association as such receives exactly the same fee for its architectural work as the individual architect would receive if he were commissioned for the same job. Out of the earnings of the association as architects the association furthers the development of architecture and fine arts through its other activities. It maintains an atelier free for the draftsmen of all architectural firms to study design under the leading architects; it maintains a school of architecture for the University of California, Southern Branch, providing quarters, materials and teachers, and it maintains an architectural and fine arts library.

The association has large drafting-rooms and quite a force of draftsmen, paying for these in the usual manner. It pays nothing to its members for the submission of sketches and the attendance at consulting meetings of several hours each. It does, however, appoint from among its members those best fitted to supervise the different parts of the work as it proceeds. The men so appointed are budgeted by the association. They are allowed just so many hours to do the work they are appointed to do and they are paid so much per hour for such work. If, as it usually happens, the member devotes two or three times as much time as he has been given for a definite job—that is his affair. He only gets the amount which he was budgeted to receive. Whatever funds are left over after meeting the actual expenses of each job, are devoted to the general community services of the association for better cultural conditions.

One of the outstanding contributions of the association was the design of the civic center for Los Angeles. Realizing that the city should have a civic center planned on a generous scale and that the nature of the work would make it difficult for county and municipal authorities to provide the money to pay to have such a plan prepared, the association expended something over $45,000 out of its own earnings as architects on public buildings during the eleven months of intensive co-operation on research and drafting work on the preparation of an entire Civic Center Plan which it gave to the county and city of Los Angeles for the nominal sum of one dollar.

The association stands on exactly the same footing as every other individual architect or firm of architects stands with reference to architectural work on any public buildings which will be built in the development of this Civic Center Plan when and if such a plan is adopted by the county and city authorities. It is in short only the plan which the association is giving to the community. If the city builds a city hall which it proposes doing; if the county builds various county buildings which they are now planning; and if the state and the federal government come in with their buildings for this new civic center, the architectural work on such buildings will be given out by the different authorities as they may see fit in each instance.

Swiss Cable-Incline Railway

A steep-grade cable-incline railway 2,300 ft. long, with grades of 53 and 73 per cent, opened in 1924, affords communication between Burgenstock, on one of the Swiss lakes, and a mountain hotel about 722 ft. above the lake. The track, of 32-in. gage, has 32-lb. T-rails bolted to ten angle-iron ties for each rail length, the ties being embedded in and anchored to a 20-in. bed of concrete. Splice bars extending under the base of the rail are secured by bolts through the upper and lower parts, but the bars extend only half-way up the rail web in order to be clear of the grip or track brakes on the cars; one brake is applied automatically if the tension on the cable ceases or if the operator fails to keep his foot on a pedal which holds the brake off; the other brake is applied by hand and is used to regulate the speed. With two cars at opposite ends of the cable a length of double track is provided to allow the cars to pass. An electric hoist at the top of the incline operates the cable. Current for the control, lighting and telephone communication is taken by the car from overhead wires. At periods of light traffic one car is used for passengers and the other, without an attendant, for baggage, but with heavy traffic each car carries passengers and has an attendant.

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Collaboration in New Edition of Thresh

REVIEWED BY HARRY E. JORDAN
Filtration Engineer, Indianapolis Water Co., Indianapolis, Ind.

THE EXAMINATION OF WATERS AND WATER SUPPLIES—By John C. Thresh, D.Sc. (Lond.), M.D. (Vict.), D. P. H. (Camb.), Honorary Member British Association of Waterworks Engineers, Consulting Medical Officer of Health, Essex County Council, Fellow of the Institute of Chemistry, etc., etc.; and John F. Beals, B.A. (Cantab.) M. R. C. S. (Eng.), L. R. C. P. (Lond.), D. P. H. (Oxon.), Bacteriologist to the Essex and Herts County Councils and Other Local Authorities. Third Edition. Philadelphia, Pa.: P. Blakiston's Son & Co. Cloth; 7 x 10 in.; pp. 590; tables, diagrams, 24 line sketches and halftones, 36 plates, index. $7.50 postpaid.

The first edition of this work, written by Dr. Thresh, appeared in 1896. In the present or third edition Dr. Thresh has as collaborators Messrs. Beale, Suckling and Martin. The volume has an added reference value in that it contains chapters on geology (of England) in relation to sources of supply and tables of analyses of a large number of samples.

In the Preface the authors state that "experiments carried on by us during the last two years at the experiment station of the Southend Water Co. show that by acting on Houston's suggestion to use excess lime, better results can be obtained than by the use of chlorine, since chlorine does not remove any of the organic matter in solution, whereas the excess lime will remove at least 50 per cent of this." The text in support of this statement is disappointingly brief but information not given in detail leads the authors to say: "With a plant allowing the limed water to stand one day before final treatment, it appears that 1 grain CaO excess per [Imp.] gallon suffices to reduce the bacteria to under 100 per c.c. and to secure the absence of B. Coli and B. Sporogenes in 100 c.c., however bad *within limits* the original water may be." This is confirmed in part by the published results of operation of certain Ohio municipal softening plants, that the authors could study with profit.

Methods of analysis and interpretation of results occupy a large portion of the text. In the section devoted to chemistry new material is found in a scheme for estimating tar acids and bases—useful in studying stream pollution from gas works; a method for the colorimetric estimation of silica; and application of Clark and Lub's indicator to softening plant control.

Under bacteriological methods the scheme for isolation of the colon group has a timely interest in the light of co-operative studies that have been going on in this country for several years. The scheme involves three steps: (1) Presumptive, (2) confirmative, (3) decisive. The presumptive test is positive when acid and gas are formed in a bile salt which is 1.5 per cent (soda taurocholate) glucose; 1.5 per cent peptone; 6 per cent litmus broth. The decimal dilution inoculation procedure is followed. The confirmative test is positive when the culture, after transplanting a loopful from (1), forms acid and gas in a bile salt which is 0.5 per cent peptone; 2 per cent lactose; 1 per cent litmus broth. The decisive test involves growth with acid reaction on a plate of bile salt which is 0.5 per cent peptone; 2 per cent lactose; 1 per cent neutral red agar; 2 per cent bitmus broth. Typical colonies are fished to litmus milk and peptone solution for evidence of ability of the organism to coagulate milk and form indol. It is stated that 75 per cent of all cultures give the presumptive test confirmation and that 99 per cent of the confirmed tests are decisive.

Judgment as to quality of a water is expressed as follows:

(1) That a water containing less than 100 bacteria capable of growing on gelatin at 20 deg. C. in three days, and with comparatively few bacteria capable of growing upon agar at 37 deg. C. in 24 hours, and which gives no indications of the presence of the Bacillus Coli group in 100 c.c. can be considered of the highest degree of bacterial purity. (2) That a water which contains over 1,000 bacteria capable of growing on gelatin and, say, over 100 capable of growing on agar, and which contains the B. Coli as defined by us in 5 c.c. or less, is probably contaminated with manurial matter and should not be used for drinking purposes, unless a thorough examination of the source has proved that such contamination is impossible. Between these extremes the water requires a more full examination and a careful consideration of the results of the chemical analysis, and of the history of the water and of its source, before a decided opinion can be expressed with regard to its purity and wholesomeness.

This can be contrasted with the recently adopted U. S. Treasury Standard which, having as a basis an approved sanitary survey and satisfactory chemical factors, leaves out of consideration counts on either solid medium and limits the B. Coli—somewhat more broadly defined—to 10 per cent positive indications in 10-c.c. portions and limits the group peak pollution of 3 out of five positive 10-c.c. samples to 5 per cent of the total number of samples examined.

While the authors make some reference to American practice, their acquaintance with it seems rather vague. The index reference to "Race's test for free or active chlorine" is found to be the ortho-tolidin test developed by Ellms in 1912 and published in the A.P.H.A. 1917 Standard Methods. A reference to American views on the interpretation of chemical results is a quotation from the 1890 Report of the Massachusetts State Board of Health. While the character of that board's work is admired the country over, it is hard to believe that there has been no progress in expression of views on chemical results in thirty-five years.

American bacteriologists will learn with amazement " what simple bacteriological tests are applied and how greatly their views with reference to the quality of a water differed from ours [the authors]. The process generally adopted is to add 1 c.c. of the water to be examined to each of ten tubes of phenolated broth, or of bile salt glucose broth and incubate." If none of these showed signs of active fermentation, the water was regarded as "quite satisfactory. If fermentation occurred in a large proportion of the tubes, the water was regarded as unsatisfactory." This seems to be a variant of the A.P.H.A. 1912 Standard Method, but if this were true, it is to be expected that the 1917, 1920 and 1923 methods are available for reference. It is also not unfair to presume that the 1914 U. S. Treasury

Standard was available; it certainly was far less lenient than that noted above. The 1924 U. S. Treasury Standard can now be recommended to the authors as expressing the blended views of about every type of American worker interested in water supply when its quality is measured by a field survey or in the chemical or bacteriological laboratory.

As one studies this text and its development, it becomes apparent that there is a need in English practice for that standardized procedure which, in the field of water supply, has been met by the Standard Methods of Water Analysis of the American Public Health Association—first published in 1908, and now again under revision with the American Water Works Association co-operating.

Even in the field of interpretation of results, certain fundamentals are laid down in the U. S. Treasury Standard—which in its editing was a co-operative product. Such a practice is far more to be desired and certainly more productive of good in quality of water supply than the situation revealed by Thresh—where a laboratory organization is able to set up any method of procedure that its own experience indicates is a good one. In the long run the greatest good comes from careful adherence to standardized methods that have as their background the experience of the leaders of the profession in the entire country.

Construction Performance and Cost Records

CONSTRUCTION PLANT, METHODS AND COSTS: The Miami Conservancy District—By Charles H. Paul, Chief Engineer. Technical Reports, Part X. Dayton, Ohio: The Miami Conservancy District. Paper; 6 x 9 in.; pp. 411; 130 halftones and line cuts. $2.

A service of importance has been performed by the publication of this discussion of construction plant, methods and costs based on the operations of the Miami Conservancy District. Categorically, the volume is Part X of the "Technical Reports" which since 1913 have one after another been put out by the engineers and other experts employed by the district on its large flood control operations. All the other reports have had to do with design and structures; this is confined as strictly to construction. However, the construction is of such variety and the discussion is so broad that the volume has more the character of a technical treatise than of an engineering report.

There are six main divisions of the text. The least of these (19 pp.) is a general description of the operation, the district organization, the equipment and the conditions of access, power supply, etc. It epitomizes the entire operation of flood control as carried out by the conservancy district. The author then in some 60 pp. describes and discusses dragline excavator performance as the outstanding machine operation of the district. There are records in this section of cable wear and costs; of the relative costs of steam and electric operation; of delays and interruptions and of accuracy of cutting, depth of cut, bucket throw, traveling speed, swinging speed, etc., the like of which can be found nowhere else in engineering writings. Costs and output figures are averaged for millions of yards of work.

There is a descriptive section of nearly 100 pp. in which each of the separate operations is summarized: Five dams, channel work at Dayton, at Hamilton, at Troy and at Franklin, machine shop and commissary. The headings are: Description, construction program, excavating plant, concreting equipment, and equipment list, prices and costs. Then come the three outstanding chapters: (1) Methods and Costs of Excavation; (2) Embankment Construction Methods and Costs; (3) Concrete Construction Methods and Costs, which make the volume one of the greatest records ever published of methods and costs of engineering construction.

Probably no more complete performance and cost records of hydraulic sluicing, dragline excavation in earth and rock and hydraulic-fill dam building have ever been made available to construction engineers and contractors. Almost as much can be claimed for the concrete work which involved bridges, conduits, spillways, roads, retaining walls, and half a score other structures.

Early Days on the Canadian Pacific

CANADA'S GREAT HIGHWAY: From the First Stake to the Last Spike—By J. H. E. Secretan. London: John Lane. Cloth; 5 x 8 in.; pp. 252; 16 halftones. 7s 6d.

"From the First Stake to the Last Spike," the subtitle of this book, conjures up for any one at all familiar with the early history of the Canadian Pacific Railway a story full of both engineering and human interest. Mr. Secretan, as one of the engineers who drove the first stake in Ontario and followed the railroad across the continent, is well fitted by experience to tell much of what took place between 1871 and 1885; his book itself is proof of how well able he is to tell the story interestingly. Mr. Secretan does not attempt to make his book a serious history of the Canadian Pacific, but rather a selection of sketches picked out at random from his own experiences. Therein the title of the book is misleading. It would have been better to have called it, "Some Recollections of Life Along the C. P. R. during Construction." As a collection of personal recollections, the book is interesting, but engineers hoping to find within its covers an engineer's story of life on the C. P. R. during construction will find it very disappointing.

Bi- and Tri-Lingual Technical Dictionaries

FRENCH-ENGLISH AND ENGLISH-FRENCH DICTIONARY of Technical Terms and Phrases used in Civil, Mechanical, Electrical and Mining Engineering and Allied Sciences and Industries, including Geology, Physical Geography, Petrology, Mineralogy, Crystallography, Metallurgy, Chemistry, Physics, Geometry, Abbreviations and Symbols, Weights and Measures, Compound Conversion Factors, etc., and a method of Telegraphic Coding—By J. O. Kettridge, F. S. A. A., A. C. I. S., Author of "French-English and English-French Dictionary of Financial and Business Terms, Phrases and Practice." Volume I, French-English; Volume II, English-French. New York: The H. W. Wilson Co. London: George Routledge & Sons, Ltd. Cloth; 7 x 10 in.; pp. Vol. I, 543; Vol. II, 594. New York, $14; in London, $12.50.

VOCABULARIO TECNICO: PORTUGUÉS-INGLÉS-FRANCÉS (TECNOLOGIA MECANICA, FACTORES DE CONVERSAO) (TECHNICAL VOCABULARY: ENGLISH-PORTUGUESE-FRENCH, Mechanical Technology, Conversion Factors)—By F. de Carvalho Henriques. Lisboa, Portugal: F. de Carvalho Henriques. Cloth; 5 x 8 in.; pp. 216; including advertisements. $1.65 or 6½ sh. postpaid.

Bi-lingual technical dictionaries are of two sorts, the first a mere catalogue of corresponding terms in the different languages, the second a semi-cyclopedic definition of terms with cross references and explanations. The former is good mainly for cablegram ordering of supplies, the latter, of course, is a necessary aid to the study of languages and the application of that study to reading and understanding of technical literature. Of the two dictionaries listed above the French-English-Portuguese book is an ordinary example of the cross-catalogue type, but Kettridge's French-English dictionary is one of the more elaborate of the complete kind and is very well done.

Utility Regulation

EFFECTIVE REGULATION OF PUBLIC UTILITIES—By John Bauer, Ph.D., Public Utility Consultant, New York City; Formerly Lecturer on Regulation, Accounting and Finance at Cornell, Princeton and Columbia Universities. New York: The Macmillan Co. Cloth; 5 x 8 in.; pp. 381; charts and tables. $2.50.

The main thesis of this valuable contribution to the discussion of public utility problems is that valuation for rate making should and "can be made practically an automatic process," thus saving the immense amount of work that utility commissions and their staffs are compelled to do over and over again to establish rate bases and gaining time for other regulative functions now almost neglected. The chief means to this end proposed by the writer are (1) valuation appraisals of existing properties (where not already available) followed by proper capital accounting for added capital, both to be based on actual useful investment; (2) a fixed rate of return on the valuation so established, subject to reasonable variations to meet special local conditions.

Legislation setting up the basic principles of valuation and rate making and authorizing the utility commissions to carry them out is advocated since, the author urges, much of the confusion and of the repetition and threshing over of old straw is due to the vague powers given to the commissions and the lack of legislative statement of guiding principles. This thesis the author sets up and supports in detail, in good expository and argumentative form.

The book is not likely to be warmly welcomed by the utilities and their supporters, for the author attacks some of the theories and methods which are their chief reliance in attempting to get high valuations and rates. Among these is reproduction cost, at present price levels, with no allowance for depreciation. Instead, the author proposes actual investment less depreciation. He also proposes a 7 per cent return on the fixed valuation for which he contends, arguing that, taking into account the large ratio of bonds and preferred stock compared with common stock, a 7 per cent return will yield 8 per cent on the common stock—which is a minor element in the securities issued to finance utilities.

Throughout, the author keeps in mind leading court decisions, and the constitutional provisions they are designed to uphold. His attitude is that the courts shun legislation and will support well defined legislative control of the utilities so long as there is no danger of confiscation or evasion of due process of law. Leading decisions of the United States Supreme Court are reviewed. These, Mr. Bauer holds, justify his main thesis and supporting arguments, especially when one passes over dicta and gets to the practical effect of the decisions, which in several instances have cut to a small fraction of the total valuation factors which the court held must be allowed in principle.

The author states that the book is designed for utility commissioners, officials of utilities on the one hand and of municipalities on the other, professional staffs of all three, investors, and also for use as a college textbook. We may add what it might possibly have been unbecoming for the author to say, that the book might be read with profit by judges on the bench. It seems likely that many of these would endorse the main thesis of the author, especially as regards the urgent need for more specific and clearer legislative definition of what shall constitute base values for rates and also on what is a reasonable rate once methods of valuation have been established.

Road Building for Canadians

PRACTICAL ROAD-BUILDING THROUGH CANADA: A Manual—By E. A. James, M. Engineering Inst. of Canada, M. Am. Soc. C. E., Chief Engineer, Toronto & York Roads Commission, Member of firm of James, Proctor & Redfern. Toronto, Ont.: The Author. Cloth; 6 x 9 in.; pp. 227; many halftones and line cuts. $2.50.

A style of treatise more familiar a dozen or twenty years ago, when Baker and Byrne and Spalding wrote on road building, than it is today in the highly technical works of Harger, Besson and Agg, is had in this volume by a Canadian engineer-author. There are introductory chapters on economics, selection of type and drainage, and then each type of road and pavement is separately described. Structure, construction and maintenance are each considered in the eight to a dozen pages devoted to each road type. As an expression of Canadian opinion on road types and practice the book is interesting. It has practical utility for the Canadian rural road official. There is little in it that offers help in road design or construction in the United States.

Norwegian Highways

HIGHWAYS OF NORWAY: A Short Account of Organization and Development of the Norwegian Highway Service—By the Director of Public Roads of Norway (A. Baalsrud). Translated into the English Language by E. Lund Hansen, C.E. Oslo: Teknisk Ukeblad. Paper; 8 x 11 in.; pp. 37; 72 halftones and charts.

Norway has records of legislation a thousand years old providing for the building and upkeep of roads and bridges. In 1274 a rather complete code of highway laws was enacted. This was replaced by a new code in 1604. In 1824 there was another revision and from it there dates the modern road system of the kingdom. This is described in all aspects of administration, construction and upkeep in the interesting report of the director of public roads of Norway translated into English by E. L. Hansen. The American road builder will find an evening of interesting and informative reading in the little book.

American Highways Through French Eyes

LES ROUTES AMERICAINES—Par A. Antoine, Ingénieur des Ponts et Chaussées. Paris: Dunnod (92 Rue Bonaparte). Paper; 6 x 9 in.; pp. 96; 43 line cuts and halftones.

An excellent short summary of highway practice in the United States is given by this French writer. Administration, construction and maintenance methods are outlined succinctly. It is noted too that the author has grasped recent practice in both design and in construction methods. The French reader will get an unusually sound and serviceable knowledge of American roads from this little volume.

Geologic Structure and Topography

INTERPRETATION OF TOPOGRAPHIC AND GEOLOGIC MAPS: With Special Reference to Determination of Structure—By C. L. Dake, Ph.D., Professor of Geology, Missouri School of Mines and Metallurgy, Rolla, Mo.; and J. S. Brown, Ph.D., Associated Geologist, United States Geological Survey. New York and London: McGraw-Hill Book Co., Inc. Flexible; 5 x 8 in.; pp. 355; 52 line cuts; index. $3.

This volume is a straightforward explanation of the relations which may exist between structure and topography. The reader is made acquainted with the common agencies that shape land form and with the appearance of these forms on topographic sheets. Preliminary

treatment is given scales, methods of indicating relief, and the interpretation of contours and contour intervals. The book is not printed for the physiographical specialist. Rather, it is written and illustrated to meet the demands for an adequate lay knowledge of geological-topographical processes.

PUBLICATIONS RECEIVED

LECTURES ON ENGINEERING PRACTICE before the School of Engineering, Johns Hopkins University (Baltimore, Md.) for the school year 1923-24 include, among others, "The Engineer in a Large Railroad Organization," by Earl Stimson, chief engineer, maintenance, Baltimore & Ohio R.R., and "The Manufacture of Portland Cement," by Richard K. Meade, consulting chemical engineer, Baltimore.

STREAM OXIDATION AND RE-AERATION are considered in the third installment of "A Study of the Pollution and Natural Purification of the Ohio River," issued as Public Health Bulletin No. 146, U. S. Public Health Service. (15c. from Superintendent of Documents, Washington, D. C.) There is first a theoretical discussion of oxygen demand, resources and balance in a stream, and then the presentation of experimental data obtained in studies of the Ohio River. The bulletin is by H. W. Streeter, sanitary engineer, and Earle B. Phelps, consultant, U. S. Public Health Service. The studies were made in 1914-15.

A THIRD EDITION of Standards of the Hydraulic Society (C. H. Rohrbach, secretary, 90 West St., New York City) has been issued. The new material includes standard nomenclature and definitions pertaining to the industry, A. S. M. E. standard dimensions for cast-iron flanges and reducers for 125 and 250-lb. steam pressures, and materials recommended for the construction of pumps to handle an extended list of chemicals and other special liquids.

A STUDY OF COASTAL GROUND WATER, with special reference to Connecticut, has been written by John F. Brown and published as Water-Supply Paper 537, U. S. Geological Survey (20c. per copy from Superintendent of Documents, Washington, D. C.). The work was done in co-operation with the Connecticut State Geological and Natural History Survey, of which H. H. Robinson is superintendent. Besides geological data and general information regarding ground water in the New Haven coastal region of Connecticut, there are descriptions of many wells, springs and pumping plants on the New Haven coast, and some 15 pp. of bibliography of coastal ground water in the United States, Hawaii, Hayti, Antigua, Great Britain, France, Belgium, Netherlands, and Germany.

LAND SUBDIVISIONS AND THE CITY PLAN, by Herbert S. Swan and George W. Tuttle, has been issued as a 16-p. supplement to the July *National Municipal Review*, (261 Broadway, New York City; 25c., or 5 for $1 or 100 for $15). After a general presentation of the subject, the author submits rules for the guidance of planning commissions in approving new subdivisions. Sketch maps and various diagrams add materially to the uselfulness of the pamphlet, which is of a much more practical character than many of the publications relating to city planning.

TRADE NAMES AND DESCRIPTIONS of Marbles, Limestones, Sandstones, Granite and Other Building Stone Quarried in the United States, Canada and other countries, compiled by Frank A. Lent and first published serially in *Stone Magazine*, has been revised and corrected and issued as a 41-p. pamphlet (Stone Publishing Co., 1328 Broadway, New York City; $1.50).

THE STORY OF THE BURLINGTON, by W. W. Baldwin, vice-president of the C., B. & Q. R.R., gives, in pamphlet form, a brief outline of the growth and traffic development of this railroad, from the 12-mile "Aurora Branch" of 1850 to the present extensive system of some 9,500 miles.

WATER POWERS OF ONTARIO are listed in a very complete tabulation prepared by the Ontario Department of Mines, in co-operation with the Dominion Water Power and Reclamation Service. Each river of any importance is included in the table and the estimated capacity of each falls or rapids at ordinary minimum flow and at ordinary six months' flow, also the installed horsepower at the present time. (Department of Lands and Forests, Ottawa, Ont.)

THE SECOND EDITION of Bulletin No. 8 of the Testing Materials Research Laboratory, "Effect of Hydrated Lime and Other Powdered Admixtures in Concrete," has just been issued. The new edition has been revised to include the two- and five-year tests which were made subsequent to the original publication of the report.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

AMERICAN PETROLEUM SUPPLY AND DEMAND: A Report to the Board of Directors of the American Petroleum Institute by a Committee of Eleven Members of the Board. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 269; 10 graphical plates, many tables. $3.

A historical review, a technical and economic review and a forecast of our petroleum resources.

ASTRONOMIC DETERMINATIONS BY UNITED STATES COAST AND GEODETIC SURVEY AND OTHER ORGANIZATIONS—By Sarah Beall, Mathematician. Special Publication No. 110, U. S. Coast and Geodetic Survey, Department of Commerce. Washington, D. C.: Government Printing Office. Paper; 9 x 12 in.; pp. 337; 25 halftone plates, many charts, maps, diagrams and tables. $0.80 from Superintendent of Documents, Washington, D. C.

BACTERIOLOGY: A Text Book on Fundamentals—By Stanley Thomas, M.S., M.A., Associate Professor of Bacteriology, Lehigh University. New York and London: McGraw-Hill Book Co., Inc. Cloth, 6 x 9 in.; pp. 201; frontispiece portrait of Pasteur and 12 halftones and line cuts. $2.50.

DIE ELASTISCHEN PLATTEN: Die Grundlagen und Verfahren zur Berechnung ihrer Formanderungen und Spannungen, sowie die Anwendungen der Theorie der ebenen zweidimensionalen elastichen Systeme auf praktische Aufgaben—Von Dr. Ing. A. Nadâi, Privatdozent der Universität Göttingen. Berlin: Julius Springer. Cloth; 6 x 9 in.; pp. 326; 187 halftones and line cuts, 8 structural mathematical tables. 24 marks, bound, gold, in Germany.

GRUNGZÜGE DER TECHNISCHEN WIRTSCHAFTS-, VERWALTUNGS- und Verkehrslehre—Von E. Mattern, Oberregierungs- und Baurat, Professor an der Technischen Hochschule, Berlin. Berlin: Julius Springer. Paper; 7 x 9 in.; pp. 350; 35 line cuts. Paper, 18, cloth, 19.5 marks, gold, in Germany.

THE MAKING, SHAPING AND TREATING OF STEEL—By J. M. Camp and C. B. Francis. Fourth Edition. Pittsburgh, Pa.: Carnegie Steel Co. Flexible, fabricoid; 5 x 8 in.; pp. 1142; 346 halftones and line cuts, 104 tables, charts, index. Bible paper, with gold edge, $7.50; 60 per cent discount to employees of U. S. Steel Corporation, educational institutions and public libraries.

Besides revision as needed, this edition has been about doubled in size, by the addition of new material. The expansion is designed to make the book meet the needs of all the subsidiary companies of the U. S. Steel Corporation, not only in the schools "but also as a reference book for their employees." The revisers have also kept in mind the extensive demands for the book from "schools and colleges of the country." The second edition was reviewed at length by W. P. Barba in our issue of Jan. 20, 1921, p. 130.

OIL REFINERY SPECIFICATION—By A. L. Nugey, M. Am. Soc. M. E. Easton Pa.: The Chemical Publishing Co. Cloth; 6 x 9 in.; pp. 210; 34 line cuts. $3.50.

Notes on requisites and elements of design, combined with tabular and graphical data and interspersed with fragments of model specifications, all presented in logical plant sequence. Mostly devoted to plant and equipment rather than structural design.

SAMPLING AND TESTING OF HIGHWAY MATERIALS—By Wm. H. Barton, Jr., M.S., C.E., Assistant Professor of Highway Engineering, University of Pennsylvania, Formerly Highway Research Specialist, U. S. Bureau of Public Roads; and Louis H. Doane, M.S., B.S. in C.E., Associate Professor of Civil Engineering, Pennsylvania Military College, Formerly Associate Professor of Civil Engineering, Clemson Agricultural College. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 355; 83 halftones and line cuts. $3.50.

STATE GASOLINE TAXES—By Edmund P. Learned, A.B., A.M., Instructor in Economics and Commerce, University of Kansas. University of Kansas Humanistic Studies, Vol. III, No. 4. Lawrence, Kansas; University of Kansas. Paper; 6 x 9 in.; pp. 94. $1.

STRENGTH OF MATERIALS—By Alfred P. Poorman, A.B., C.E., Professor of Applied Mechanics, Purdue University. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 313; 211 line cuts and halftones. $3.

DER TALSPERRENBAU—Von P. Ziegler, Regierungs- und Baurat zu Clausthal. Dritte Neubearbeitete Auflage. Band I: A, Gesichtspunkte für die Anlage grosser Wasserkraft- und Wassersammel-Anlagen; B, Talsperren aus Erde und Losem Steinmaterial. Berlin: Wilhelm Ernst & Sohn. Paper; 6 x 9 in.; pp. 247; 337 halftones and line cuts. Paper, 24, cloth, 26 marks, gold, in Germany.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Two Engineers on Fort Worth City Plan Commission

Sir—In your issue of July 30, 1925, p. 196, the fifth member of the City Plan Commission of Fort Worth is referred to as a "laundryman." Said laundryman is Count B. Capps, a 1921 graduate of the Massachusetts Institute of Technology, editor of *Tech* during his junior and senior years and one of the most accomplished young men in Texas. He happens to own a large modern steam laundry, among many investments which he manages like a business man of middle age.

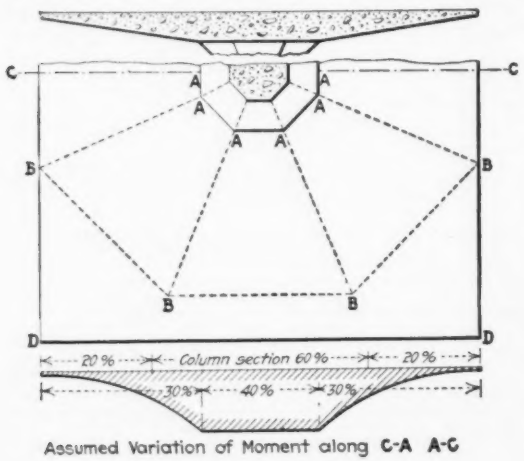
JOHN B. HAWLEY,
Consulting Engineer.

Fort Worth, Texas,
Aug. 3, 1925.

[The local source of information on which our note was based disclosed nothing about Mr. Capps' occupation or attainments except that he was a "laundryman"—such is fame in Fort Worth! Our apologies to Mr. Capps.—EDITOR.]

Cantilever Floor Construction Stresses

Sir—Your correspondent, N. K. Sheppard, in *Engineering News-Record*, June 25, 1925, p. 1072, presents some figures for computed compressive stresses in the Printcraft Building. The statement in the description of this building in *Engineering News-Record* of May 21, 1925, p. 845, that "each section of the octagon is designed as a cantilever bracket in itself" is a general description of the action of the structure in the normal case of abutting segments, rather than a complete formula for the analysis of all variations of the "unit slab." While Mr. Sheppard's figures



SECTION OF CANTILEVER FLOOR

are arithmetically correct, he errs seriously in condemning the structure on the basis of such an analysis. Literal application of the method would indicate infinite stress on a zero width at the center of the octagon on the axis of the column, and the design of all spread footings and similar structures would become impossible.

It is easy to see that the moments computed by Mr. Sheppard are not the only moments normal to *A*, *A* in the accompanying figure, for the slab may be cut just back of the line *A*, *A*, *A*, *A* and still be stable. It is also easy to see that in computing the bending moment normal to *A*, *A*, he has neglected those components normal to *A*, *A*, of the moments which obviously exist across the lines *A*, *B*.

Without elaborating on our analysis of this structure, it may be pointed out that the bending moment on the section *C*, *A*, *A*—*A*, *A*, *C*, in the accompanying figure, can be determined very definitely for balanced loading by statics. It is the moment of the couple formed by the loads on the area *D*, *C*, *A*, *A*—*A*, *A*, *C*, *D*, downwards, and the equal shear uniformly distributed along the face *A*, *A*—*A*, *A* upward. This moment is distributed along *C*, *A*, *A*—*A*, *A*, *C*. For unbalanced loading, the moment along this line will be smaller than before, but more of it will be concentrated along *A*, *A*—*A*, *A*.

We figure as follows:

Bending moment along *C*, *A*, *A*—*A*, *A*, *C* due to balanced loading .....6,800,000 in.-lb.

Resisting moment considering this whole section effective at an outer fibre stress 800 lb. per sq.in. .....6,850,000 in.-lb.

Bending moment along *C*, *A*, *A*—*A*, *A*, *C* due to unbalanced loading, assuming that a section around the column head rotates as a whole about a horizontal axis .....5,700,000 in.-lb.

Resisting moment of section *C*, *A*, *A*,—*A*, *A*, *C* as a beam acting as a whole with fibre stress varying from 900 lb. per sq.in. at the lower surface to zero at the neutral surface.....5,600,000 in.-lb.

Mr. Sheppard wishes us to neglect entirely the Moment along lines *A*, *B* and resistance along the line *A*, *A*—*A*, *A*, a bending moment 6,150,000 in.-lb.

A study of the figure will show that the assumed distribution of the resisting moment is not unreasonable. Also, if Mr. Sheppard will compare these moments with the total moment which it is customary to figure in flat slabs or in spread footings, he will see that the design here is conservative as compared with that in similar structures. The economies effected in the quantities of materials in our design are very pronounced, owing to the fact that we place the concrete where it is most effective in resisting the critical moments and in increasing the lever arm of the steel. This saving of material and the economies effected by simplifying the making, placing and stripping of forms, getting rid of all bending of floor steel and eliminating expensive wall columns, make it possible for us to figure conservatively on the basis of simple principles of mechanics.

Mr. Sheppard's comment that low stresses in the steel mean lower stresses in the concrete for a given depth is no more true here than in any other concrete member in bending. It does not follow, however, that "a relatively low steel working stress is most favorable to this design," or to any other design. We used 18,000 lb. per sq.in. for high-carbon steel in this design.

Mr. Sheppard also claims that the filler slab should be provided with bottom steel. This would seem to be a question of satisfaction to the client rather than one of structural safety. It is evident that the cantilever design, with steel crossing the filler slab in the top and adequate provision for bending in the columns, gives a safe and stable structure. Omitting bottom steel may lead to some cracking in the bottom of the filler slab, but these cracks are in no way dangerous. In only one case have we ever observed them in our designs, in spite of some very severe test loads.

In the Davis Building, recently completed in Chicago, a small office building two stories high, 35 x 65 ft., with two double columns, a small crack showed along the bottom of the filler slab of the 33-ft. span of the roof when the forms were struck. For an acceptance test conducted by the city this entire span between columns was loaded on the second floor. I figured the load at 385 lb. per sq.ft., but the city's engineers gave credit for only 357 lb. (design load, 100 lb. per sq.ft.). Measurements of deflection were made at the center of the slab and at four points along the walls. That at the center was $\frac{1}{16}$ in. (about 1/2100 of the span), with no measurable deflection elsewhere. Except for the crack referred to, which we think may properly be attributed to the special features of this design, no other cracks were observed in this building. When the load was removed from the Davis Building the floor reacted or came back 100 per cent instantly.

C. B. FOSTER,
Foster Engineering Service Co.

Indianapolis, Ind.,
July 14, 1925.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

No Convictions in Pickwick Club Collapse Case

Boston Jury Acquits the Twelve Men Indicted—Expert Witnesses Disagree

Ten of the twelve men indicted in connection with the collapse of the Pickwick Club building in Boston on July 4 and the consequent loss of 44 lives, were acquitted last week by direction of the presiding judge. The remaining two were declared not guilty by the jury. The defendants, as noted in our issue of July 16, p. 115, included the sub-lessee of the building, the agent for the owner of the property, the contractor who was repairing the building, the heads of the dancing club in the building, the supervisor of construction for the city of Boston, an architect employed in connection with repairs to the building, the heads of the contractors who were putting in a new garage next door to the building which failed, and the head of the firm of architects which had planned this adjoining building. Some of these men were indicted only for maintaining a nuisance, but most of them were indicted for manslaughter.

The trial took three weeks. Putting aside the question of responsibility which was not satisfactorily settled and the confusion as to which doubtless was the main cause for the direction of a verdict of acquittal of the ten men by the judge, the major interest in the trial centered on testimony as to the cause of the failure. The district attorney maintained that the failure was due to the overturning of one or more of the 2x4-ft. concrete piers which had been placed under the wall of the building in the process of excavating for the adjoining new garage. This 20-in. brick wall was set on seven concrete piers about 7 ft. high. The excavation was carried nearly to the bottom of these piers on one side. On the other side, the cellar of the building was about 14 ft. above the bottom of the excavation. Underlying this cellar floor and pressing against the 20-in. brick wall and the 24-in. piers was 14 ft. in depth of blue clay and blue clay mixed with sand. Prof. George F. Swain, of Harvard University, testifying as expert for the presecution, contended that the earth pressure on this 14 ft. of clay under the old building caused a retaining-wall failure of the piers. Maj. Gen. George W. Goethals, testifying as expert for the defense, said that the failure was due to poor concrete in one of the inside of the seven piers. He said that from the condition of the concrete seen in the excavation and from samples of it at the Watertown Arsenal, in his opinion the pier could not stand the strain and therefore crushed beneath its vertical load. He said that the earth under the old building could not cause any lateral thrust because there could be no lateral pressure until the breaking off of the face of the bank occured. In his opinion, there was no such break.

The two men who were acquitted by the jury were James J. Hendrick, the city inspector of buildings in whose district the structure was located and Lawrence Perkins, general foreman for the contractor who was building the garage adjoining the Pickwick building.

Engineering Fifty Years Ago

From *Engineering News*, August, 1875

The Weight of Rails

RAILROADS with a heavy traffic requiring powerful locomotives, 11,000 to 12,000 lb. per wheel, in order to haul maximum trains and keep down the expenses of their train service, really cannot afford to lay any but steel rails in their main tracks. Railroads with a moderate traffic, which cannot as yet afford to buy steel rails, and have from 10,000 to 11,000 lb. on their engine wheels, should stipulate for the hardest iron it is possible to place in the heads of their rails, with a due regard to perfect welding; while those with a light business would actually find it more profitable to sell any locomotives with more than 10,000 lb. per wheel, than to have them crush and destroy the iron rails now laid in their tracks, before the growth of the country furnishes a remunerative business.

It is therefore suggested, as of more pressing importance to many of our American railroads, that they should presently proportion their machinery to the rails now laying upon them, than to endeavor to adapt the rails to the machinery. In the building of new roads, the weight and character of the rails have been governed by financial rather than truly economical considerations. Railway presidents and directors have consulted the treasurer rather than the engineer. The latter should therefore endeavor now, so to have the engines proportioned as not to exert crushing strains on the rails.

Keays Quits Moffat Tunnel Work

R. H. Keays, chief engineer of the Moffat Tunnel Commission, has resigned to become chief engineer of the Marathon Water Supply Project, Athens, Greece, an eleven million dollar project recently let to the Ulen & Co. of New York. Mr. Keays is expected to leave for Greece about Sept. 1. George Lewis who has been in charge of the field work on Moffat Tunnel will relieve Mr. Keays.

Water Tank Collapses Injuring Two

General Corrosion of Steel and Faulty Tierods Believed to Be Chief Factors in Failure

Two boys were injured, one of them perhaps fatally, when a wood-stave water tank, supported on a steel tower, and located in the vacant lot adjoining 410 West 27th St., New York City, collapsed Monday morning. The tower was about 60 ft. high and the capacity of the tank was 20,000 gal. The tower was practically an independent structure, though its two east columns were set against the wall of the four-story brick building which is No. 410, and tied to the brick wall near the top of the building. When the collapse occurred a large hole was torn in the wall between the third and fourth floors. The west columns of the tower were set in heavy concrete footings in the vacant lot. The collapse was a buckling rather than a tipping of the tower, most of the wreckage being near the site of the west column footings.

Frederick C. Kuehnle, chief inspector of the Bureau of Buildings, has started an investigation of the cause of the accident, though after some examination of the premises and wreckage by himself and others of his staff, he is able to say only that "corrosion wa. a contributing factor." A definite explanation of the cause of failure is hampered by the fact that no available data exist on the original design of the structure. The tower was erected about 25 years ago and a new tank was set only a few months ago. There are no plans in the Building Department of the original structure, as at that time it is believed that the Fire Department controlled erection of such structures.

After further investigation Mr. Kuehnle said:

"I have been informed that some insurance company inspected the tank less than two months ago and pronounced it all right. That might well have been done as the corrosion was almost at the top of the structure, or at least forty feet above the ground. It would have required a steeple-jack to find out about it while the tank was still standing."

The columns of the tower were built up of 6-in. angles with their vertices meeting to form, in effect, a square column section. The angles were tied together by a half-inch plate about 4-in. wide there being two bolts run through each of the angles. There were four bays in the column height. At each of these connections heavy gussets were put in and from these gussets ran the swaybracing of ¾-in. steel rods. Though this bracing was of ¾-in. material, to each rod at its connection with the gusset was welded a 1-in.

(*Continued on p. 321*)

Sir Adam Beck of Ontario Hydro Commission Dies

Sir Adam Beck, chairman of the Ontario Hydro-Electric Power Commission since its organization nearly eighteen years ago, died at his home in London, Ont., on Aug. 15. Sir Adam was a native of the Province of Ontario and was elected to the Provincial Legislature in 1902. Immediately he took an active interest in the development of electric power at Niagara Falls and was appointed the following year to a commission to investigate the possibilities of such power development. Three years later he introduced the bill which created the Ontario Hydro-Electric Power Commission and when the commission was appointed was made its chairman. He always was an active advocate of government ownership and development of power, and it was largely through his efforts that the Ontario commission was expanded to its present size with an investment of $190,000,000.

Southern Pacific Ry. Proposes Further Extensions in Texas

The San Antonio & Aransas Pass Railway Co., a subsidiary of the Southern Pacific Co., which has an application pending before the Interstate Commerce Commission for authority to build an extension of its line in Texas south from Falfurrias in Brooks County into the Rio Grande valley along the Mexican border, has now applied to the commission for authority for an additional extension from Edinburg in an easterly direction to Harlingen, a distance of 30 miles. This application brings the total proposed mileage up to 115.

Health Engineering Work of South Carolina Reorganized

All the engineering activities of the State Board of Health of South Carolina have been merged in an engineering division by recent action of the board and placed under the direction, as acting chief engineer, of L. M. Fisher, associate sanitary engineer, U. S. Public Health Service. Besides Mr. Fisher, the personnel of the division will consist of three assistant engineers, a malaria epidemiologist, and a clerk. Three of the sixteen county health units of the state will operate under the engineering division because of the importance of malaria as a health problem in those counties.

Besides malaria control work and investigations, the engineering division will have charge of the sanitation of water and milk supplies, shell fish, and sewage disposal, and also the collection of morbidity statistics. The latter has been placed under the division because at present there is no other agency under the State Board of Health for collecting morbidity statistics and also because of the relation of morbidity statistics to malaria control. As an aid to the collection of morbidity statistics, franked post cards are mailed weekly to physicians with instructions to return the card even if there are no diseases to be reported. From 60 to 80 per cent of the physicians are now reporting as compared with about 10 per cent or less when the physicians were merely supplied with a bunch of cards with instructions to fill out and mail a card each time he had a case of communicable disease to report. This improved method of reporting, we are informed by Mr. Fisher, will enable the State Board of Health "to form an intelligent estimate of the prevalence of communicable diseases and to take early steps in suppressing them and preventing epidemics."

Dr. James A. Hayne is secretary of the South Carolina State Board of Health and state health officer. Headquarters are at Columbia.

Flood Does Little Damage to Rio Grande Project

River Flow Reaches 13,500 sec.-ft.—Soldiers and Farmers Help Maintain Levees

Special Correspondence

During the week ending Aug. 1, 1925, heavy rainfall on the drainage area below Elephant Butte storage reservoir, Rio Grande Federal Irrigation Project, discharged through arroyos into the river a series of flashy floods, peaking at the Percha diversion dam with a discharge of 13,500 sec.-ft. This amount flattened to a crest of 10,500 sec.-ft. at Leasburg diversion dam 60 miles below, and to 8,400 sec.-ft. at El Paso, with 4,900 sec.-ft. at Fabens, Texas, the lower limits of the Rio Grande project. Smaller discharges immediately previous had somewhat scoured the river bed, and with considerable emergency maintenance the limited levee protection in the vicinity of El Paso was able to withstand the increased gage height.

The river channel through the lower portion of the project where it forms the boundary line between the United States and Mexico has become largely reduced in cross-sections, due to the storage, control and diminution of the irrigation supply, over conditions previous to the construction of the storage unit. The ordinary discharge at Fabens, Texas, for irrigation purposes is about 300 sec.-ft., and the increase to 4,900 sec.-ft. flooded several thousand acres of low lands adjacent to the river and found entrance into one of the main drains in what is known as the Tornillo section.

The total area of land flooded by this sudden flashy rise in the United States was 10,800 acres, of which approximately fifty per cent were in cultivation. The total loss of every character is estimated at about $100,000. Farmers, county and reclamation crews operated energetically in maintaining levees and preventing further encroachment of flood discharge upon cultivated lands. A large detachment of troops from Fort Bliss were also detailed for flood work.

Considerable emphasis is placed upon the necessity for providing a suitable water way and control works for the Rio Grande, particularly in the El Paso portion, where it is the boundary line between the United States and Mexico.

Buffalo-Fort Erie Bridge Over Niagara Approved

Members of the International Joint Commission, following a hearing at Niagara Falls, Ontario, on August 11, stated that they would recommend approval of the proposed bridge across the Niagara River from Buffalo, N. Y. to Fort Erie, Ontario. The present plans call for four steel arches over the river having a total length of 1655 ft. and a 360 ft. through truss over the Black Rock canal, and long approaches on both sides of the river giving the bridge a total length of nearly a mile. The span over the ship canal will have a clearance of 100 ft. and the roadway from this high point will be on a descending grade over the four arch span toward the Canadian shore of 2.94 per cent.

Maine to Vote on Export of Power in September

In order to make it possible to export power developed at the projected tidal power plant on the Bay of Fundy on the international boundary between Maine and New Brunswick, the state of Maine will take a referendum, Sept. 14, on a proposal to amend the present law which prohibits the export of power.

Dexter P. Cooper made application to the Federal Power Commission for a preliminary permit to develop power on the Bay of Fundy in 1924 but the commission decided that the project should be referred to the International Joint Commission as noted in *Engineering News-Record*, June 19, 1924, p. 1075. The Federal Power Commission doubts the feasibility of the project.

Change of Government May Affect Hydroelectric Development

The change of government in the province of New Burnswick, Canada, as a result of the recent election, will probably involve the abandonment of, or a long delay in, the projected hydroelectric power development at Grand Falls. The contract for this work was let recently as noted in our issue of August 13, page 282, but as the government which is now coming into power is opposed to having the government develop power, it is probable that the contract will be cancelled.

Baltimore Strike Ends

The strike of union workers, members of the Allied Building Trades Council of Baltimore, which was noted in our issue of August 6, page 234, has been ended through the agreement of the striking workmen to accept the decision of a special board to arbitrate on the "current rate of wages." The strikers have returned to work and the municipal building program is being pushed. The board of arbitration consists of a representative of the municipality, of the Public Improvement Commission under whose direction the city work is being done, of organized labor, of the contractors, and an economist to be selected by the other four members.

Davison Leads in Second Ballot of Am. Soc. C. E.

The result of the second ballot for official nominees for officers of the American Society of Civil Engineers is as follows: For President, George S. Davison 2975, and John T. Coleman 1970; for vice-president, Zone I, Allen Hazen, 818, Ira W. McConnell, 754; for director, District 5, Donald H. Sawyer 168, Harry A. Lane 94, Allen J. Saville 84. There is no contest for vice president in Zone IV or for director in districts 3, 7, 8, 9, and 12.

These names will be entered on the letter ballot to be sent out not less than 30 days before the annual meeting in January as the official nominees.

Time Extension Denied Coal Mine Owners in Pollution Case

Refusal to grant coal mine operators who are polluting certain public water supplies an extension of time beyond July 29 to work out a plan to carry the drainage through a tunnel to a point below the reservoir on Indian Creek was made by the Fayette County Court of Pennsylvania. The original suit was brought by the Mountain Water Supply Co., the Pennsylvania Railroad Co. and others to restrain the Melrose Co. and twenty other companies and individuals from polluting Indian Creek with coal mine drainage. The county court first denied the application for an injunction but was overruled by the Pennsylvania Supreme Court, as summarized in *Engineering News-Record*, May 28, p. 901.

Water Tank Collapses

(*Continued from p.* 319)

short length of threaded steel. Examination of a number of these welds indicates that some were poorly made. At one particular weld, which was on the rod that ran upward from the second bay, the steel showed old corrosion clear through the section, indicating the possibility that this rod, an important tension member, had been holding but ineffectually for some time. Other welds showed that scant connection had ever existed between the threaded length and the rod. It is conceivable that some extraordinary vibration, such as the passing along the street of a heavily-loaded truck, could have caused one or more rods entirely to let go.

Another possibility of the cause of failure rests in the fact that the tank apparently fell, rather than toppled. As said before most of the wreckage landed near the bases of the west columns. It is conceivable that the floorbeams under the tank may have been faulty. They were timber, but as none seems to know of what dimension or how they were placed, they are not easily found in the wreckage. Identification of these may shed some other light on the cause of the failure.

The rivets were good, not a single rivet being found that had sheared through, the steel tearing usually before the rivet failed.

New York City Engineers Ask Pay Increase

Submit Diagrams Showing that City's Engineers Get Less Wages Than Mechanics and Teachers

Engineers in the employ of the City of New York have organized as the Association of Engineers of New York and have protested to the city authorities against the unfairly low salaries now paid the city's engineers. On Aug. 10 a meeting was held at which some 150 delegates representing engineering employees of the municipal departments were present and at which a letter was drafted to submit to the Board of Estimate requesting a 25 per cent increase in engineering salary schedules for the coming year.

Accompanying the letter were four charts showing th status of engineering pay in the City of New York and the relation of that pay to that of other city employees. Only one of the graphs is shown herewith, but it is a composite of the other three. This graph shows the percentage of increase in the compensation of the foremen mechanics, mechanics, unskilled labor, teaching service, engineering service, and legal service of the city between 1914 and 1925. As will be seen, it shows that not only are the engineers paid less than any of the groups, except the unskilled labor group, but that its increase of pay in the ten years of high cost of living increase has been less than any of the other groups except that of the legal profession, which was already compensated in 1914 far above any of the other groups.

The other charts show that 10 per cent of city engineers in 1925 receive less than unskilled labor as against 5 percent in 1914; that 76½ percent of the engineers receive less than mechanics as against 34½ percent in 1914; that 88 percent of the engineers in 1925 receive less than foremen mechanics compared with 50 percent in 1914.

The meeting on Aug. 10 adopted a resolution recording the association being opposed to a strike or walkout in the association's effort to obtain salary increases for city engineers and recommended that any movement for betterment of conditions should be free from coercion at all times, in keeping with the dignity of professional employees.

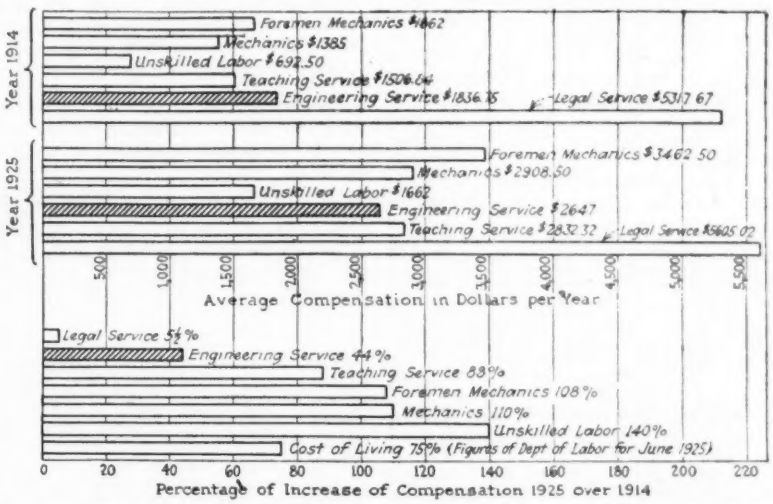

Year 1914
Foremen Mechanics $1662
Mechanics $1385
Unskilled Labor $692.50
Teaching Service $1506.64
Engineering Service $1836.15
Legal Service $5317.67
Year 1925
Foremen Mechanics $3462.50
Mechanics $2908.50
Unskilled Labor $1662
Engineering Service $2647
Teaching Service $2830.32
Legal Service $5625.02
500 1,000 1,500 2,000 2,500 3,000 3,500 4,000 4,500 5,000 5,500
Average Compensation in Dollars per Year
Legal Service 5½%
Engineering Service 44%
Teaching Service 83%
Foremen Mechanics 108%
Mechanics 110%
Unskilled Labor 140%
Cost of Living 75% (Figures of Dept of Labor for June 1925)
0 20 40 60 80 100 120 140 160 180 200 220
Percentage of Increase of Compensation 1925 over 1914

CHART SHOWING COMPARISON OF RATES AND INCREASES OF COMPENSATION OF VARIOUS CLASSES OF NEW YORK CITY EMPLOYEES

Compiled by the Association of Engineers of New York

Schlesinger Made Highway Head in Ohio

George F. Schlesinger, former state highway engineer, has been appointed director of highways and public works of Ohio, to succeed L. A. Boulay, whose term expired Aug. 10.

Mr. Schlesinger is a graduate of Ohio State University with the degree of civil engineer in 1907. For a number of years he engaged in the practice of his profession, principally in railroad engineering. He was a division engineer with the Rock Island Lines in Kansas and Missouri for about five years. In the fall of 1913 he became a member of the faculty of Ohio State University in the Department of Civil Engineering and left there during the war for government employment as an engineer on the construction of the Columbus Reserve Depot. He entered the Highway Department as division engineer in the Cincinnati District in 1920 when A. R. Taylor was commissioner. He was later promoted to chief engineer of construction and resigned during the administration of L. C. Herrick. When Governor Donahey appointed L. A. Boulay director of highways and public works, July 1, 1923, Schlesinger was made state highway engineer.

Mr. Schlesinger is a past-president of the Central Ohio Section, Am. Soc. C. E., and president of the Ohio Engineering Society and of the Columbus Engineers Club, and a member of the State Parks Committee of the Ohio State Conference on City Planning. He is also serving on several committees of the American Association of State Highway Officials.

Montreal-South Shore Bridge Steel Work Bids Asked

The Harbour Commissioners of Montreal are calling for tenders for the steel superstructure of the Montreal-South Shore bridge and for the substructure of the north half of this bridge. Contracts for the substructure of the south half were let some time ago and the work is under way. The southern half of the bridge from St. Helen's Island to the south shore will be a deck truss bridge and the northern portion over the main channel of the St. Lawrence River will have a cantilever span of 1097 ft. and a clearance of 163 ft. above high water. The estimated cost of the whole project is $8,000,000.

Lower Court Rules Against Part of Denver Zoning Ordinance

A district judge in a Colorado court has held to be unconstitutional because "unreasonable, arbitrary and confiscatory" a portion of the Denver zoning ordinance prohibiting the construction of business buildings within 300 ft. of a parkway. The buildings in question were stores facing a new high school building, in a section originally zoned for light industrial purposes. To comply with the ordinance would require 25 ft. more set back than was proposed, which the owners declared would not have left room for the buildings. The case had been before the zoning board of adjustment, which had refused to make an exception. An appeal from the injunction granted by the district court is expected.

45-Mile Pipe Lines to Be Built in Alberta, Canada

Surveys are under way for the most feasible route for an oil pipe line from the Turner Valley gas and oil fields to Calgary, Alberta, a distance of 40 miles, to bring oil to the recently completed $2,500,000 oil refinery of the Imperial Oil Co. at the latter point. It is understood that the proposed pipe line have electrically welded joints.

The construction of an additional pipe line to transport natural gas from the Turner Valley field to Calgary will also be undertaken this year. The gas pipe line will not necessarily follow the line of the oil pipe as the latter is for gravity flow.

Los Angeles to Purchase More Owens Valley Land

A number of committee meetings were held in Los Angeles during July to work on details of the proposed purchase by the city of land in Owens Valley, desired in connection with extensions of the city's water supply system. Approximately 15,000 acres of land is included in one proposal which is reported to be receiving favorable attention. The matter is largely in the hands of the board of water and power commissioners which has been working on the subject for over two years and has in this time made extensive additions to the city's holdings in Owens Valley.

WASHINGTON NOTES

After twelve years of intensive work, the Valuation Section of the Interstate Commerce Commission is beginning to see the end of its task. Two more fiscal years are expected to see the completion of basic valuations. These will be values of certain dates and are regarded primarily as rate-making values.

To date, $25,000,000 have been spent on valuation. While this total includes some rather sizable sums which were expended for work that had to be done in a different way in the light of new knowledge as the work progressed, yet those who followed the work closely believe the task, as a whole, has been done more thoroughly and accurately than any one at its beginning would have predicted.

One of the things which the long years of effort have revealed, it is said, is the fact that nothing short of a physical inventory would have sufficed for the purpose.

Several of the former opponents in Congress of the valuation effort now are said to be convinced that it is worth all it has cost.

The Commission has made no estimate as to the total which the completed valuations will show. Outside estimates, however, based on the figures the Commission has gathered, place the aggregate at from $17,500,000,000 to $20,000,000,000.

Impounding of water at the Muscle Shoals dam was discontinued August 10 so that the full flow of the Tennessee river may be available for navigation uses. The stage of the Tennessee is lower than at any other time on record. Navigation of that stream is seasonal and no great loss results from its interruption, but vigorous complaints have been registered by those concerned with operations on the Mississippi river. Difficulties are being experienced in navigating that river just below Cairo. Gen. T. Q. Ashburn, the head of the Inland Waterway Service, contends that the diversion at Muscle Shoals is partially responsible for his troubles. Gen. Edgar Jadwin, the acting Chief of Engineers, is convinced that this is not the case, but to prevent any feeling that this is responsible, he will withdraw no further water until higher stages are available.

Gen. Jadwin points out that the Wilson dam has been built at large costs for the improvement of navigation and for the development of the power resources of the river. Loss of revenue from the sale of power, alone, approximates $1,000 per day.

A report to the effect that the Commerce Department is working out a plan to enforce simplified practice and standardization agreements is denied vigorously by Secretary Hoover. There never has been a thought of anything other than to prompt industry to do these things for itself. Usually adherence to the simplified program is its own reward, but in the exceptional cases where producers have not lived up to the agreement, the industry itself, Mr. Hoover stated, has found little difficulty in securing compliance when the matter is taken up formally with the offending member.

Sir Henry Maybury, British director general of roads, will arrive in New York August 23. He is coming principally to study traffic conditions in New York state but probably will visit Chicago and Detroit before his return. He will spend three weeks in this country.

The final hearing before the Federal Power Commission in connection with the Girand project at Diamond Creek in the Colorado River has been postponed until Oct. 20. The time had been fixed tentatively for the first week in September, but on the application of those opposing the license and with the concurrence of Mr. Girand, the power commission has set the new date. The Commission asks that objections be filed in writing prior to the meeting but an opportunity for oral argument will be afforded at the hearing, regardless of whether documents have been filed.

Random Lines

A Master Craftsman

"One whose daily walk to his office takes him past a place where a small army of workmen are digging through solid rock an enormous and deep cavity in preparation for the building of another great skyscraper finds it hard to get by the place, so fascinated is he by the mingled power and delicacy shown by the three or four big steam shovels at work there. He had not realized what wonderful machines they were, or what skill was required for their manipulation in the performance of their diversified tasks.

"One man governs the many motions of each, and they are strangely docile monsters. So impressive was the art he exhibited that curiosity prompted inquiries as to the reward he received for his work. It was learned that his wage for a forty-four-hour week was $71.50, with double pay for overtime.

"To one to whom that work seemed beyond the doing of any except long-trained specialists, the amount surprised by being small. But how many in the multitude holding jobs called 'white-collared' get anything like as much—or ever will, for that matter? And how vastly more interesting—how vastly worthier of hand and brain than standing behind a counter, subject to the capricious favor of customers who often do not know what they want—is the activity of such a man as he! To be sure, he stands at his levers in blue overalls, and strident noises beat upon him all day long, but no man looks at him without envying him his ability and the exercise of it.

"Only the man who invented the machine he operates is his better."—From the "Topics of the Times" column of the New York *Times*.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER-WORKS ASSOCIATION, Boston, Mass.; Annual Convention in connection with trip on St. Lawrence River, Sept. 8-11, 1925.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Fall Meeting, Montreal, Que., Canada, Oct. 14-16, 1925.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York City; Annual Convention, St. Louis, Mo., Oct. 19-22, 1925.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Lakeland, Fla.; Annual Meeting, Des Moines, Iowa, Oct. 26-30, 1925.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Annual Convention, Detroit, Mich., Nov. 18-20, 1925.

The American Concrete Institute announces that its 1926 annual convention will be held in Chicago, Feb. 23 to 26, at the Sherman Hotel.

The North Carolina Section of the American Water Works Association will hold its second annual conference Sept. 14 to 16, in Asheville, N. C., Battery Park Hotel. Subjects for papers are: Coagulating Basin Efficiency, Filter Upkeep, and Corrosion.

The American Society of Agricultural Engineers has transferred its headquarters from Mount Clemens, Mich., to St. Joseph, Mich. Raymond Olney, who has served the Society as secretary for the past four years in conjunction with his duties as editor of *Power Farming* will hereafter devote his entire time to the affairs of the Society including editing its monthly journal, *Agricultural Engineering*.

The American Association of State Highway Officials will hold its annual convention, at Detroit, Mich., Nov. 18 to 20, 1925. Some of the principal papers will be: Economies and Methods of Widening and Strengthening Pavement, by William H. Connell, deputy secretary of highways and engineering executive for Pennsylvania; Highway Police and Highway Safety Devices, by John A. Macdonald, state highway commissioner, Connecticut; Are Toll Bridges and Toll Ferries Justified on a State Highway System? by William E. Atkinson, chairman of the State Highway Commission of Louisiana; Fundamental Principles Governing Collection and Expenditure of Gasoline Taxes, by Ray A. Klein, state highway engineer of Oregon; Our International Relations as Shown by the Pan American Road Congress at Buenos Aires, by Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads; and Pay-as-You-Go Plan of Highway Finance, by J. T. Donaghey, state highway engineer of Wisconsin. E. W. James, chief of the division of design, U. S. Bureau of Public Roads, will report on the activities of the joint board appointed to select a system of transcontinental and inter-sectional highways to be marked uniformly and equipped with uniform safety devices.

Personal Notes

ARTHUR O. RIDGWAY, chief engineer of the Denver & Rio Grande Western Railroad Company, has been elected chief engineer of the Denver Union Terminal Co.

D. J. PRICE, engineer in charge of development work in the Bureau of Chemistry, U. S. Department of Agriculture, has resigned to take up work with the Mine Safety Appliance Co., Pittsburgh, Pa. During the past eleven years Mr. Price has carried on important investigations on the causes of dust explosions, such as occur in the handling of grains, flour, starch, sugar and other products, and the means of prevention and control, with the result of greatly reducing the risks of losses from such explosions.

THE INDIANA HIGHWAY COMMISSION ENGINEERING DEPARTMENT personnel has been completely reorganized as the result of a conference between Governor Jackson and John D. Williams, director of the commission. FRANK KELLAM of Indianapolis, head of testing work, is appointed assistant to WILLIAM J. TITUS, chief engineer, and will be in charge of bridge work. J. T. NALLETT, Indianapolis, was made assistant to Mr. Titus in charge of roads. P. D. MEISENHELDER will succeed Mr. Kellam. The action is subject to approval of the entire commission. HARVEY G. SHAFER, who has been for a year chief of the division of equipment of the commission, has asked by letter from Florida to be relieved of the responsibilities of his office.

HARRY J. KIRK, of Defiance, Ohio, formerly chief engineer, Bureau of Maintenance, Ohio State Highway Department, has been appointed state highway engineer to succeed G. F. SCHLESINGER whose appointment to the position of director of highways and public works of the state of Ohio is announced elsewhere in this issue. Mr. Kirk is a native of Defiance and was educated as a civil engineer at Notre Dame University, graduating in 1913. The same year he was appointed assistant engineer in the State Highway Department and has served continuously in that department except for a year and and a half.

S. P. COFFIN, division engineer, Worcester, Nashua & Portland Division of the Boston & Maine R.R., headquarters Nashua, N. H., has been made division engineer, Terminal Division, headquarters Boston. JOHN J. ROURKE, division engineer, Terminal Division, is appointed chief of roadway machinery, headquarters Boston. JOHN P. CANTY, division engineer, Berkshire Division, headquarters North Adams, becomes division engineer of combined Fitchburg-Berkshire Division, headquarters Greenfield. R. H. PARK, division engineer, Fitchburg division, headquarters Fitchburg, becomes division engineer, White Mountains-Passumpsic Division, headquarters Woodsville, N. H., FRANK E. SAMPSON, division engineer, Connecticut River and Passumpsic divisions, headquarters St. Johnsbury, Vt., becomes division engineer, Connecticut River Division, headquarters probably Springfield. GUY H. WATSON, division engineer, White Mountains Division, becomes acting division engineer, Portland Division, headquarters Salem, succeeding George K. Thornton, who is acting engineer in charge of maintenance-of-way, headquarters Boston.

GEORGE W. FULLER and C.-E. A. WINSLOW are included in the consulting editorial board of eight health experts of the reorganized editorial staff of *The Nation's Health* (Chicago, Ill.), a monthly magazine of which Prof. Winslow has been editor. Mrs. Susa P. Moore is the managing editor.

WARD BARNUM is now permanently located in Memphis, Tenn., as appraisal engineer with the Memphis Power & Light Co.

C. J. S. WILLIAMSON, formerly assistant secretary, Regional Planning Commission of Los Angeles County, and recently office manager, County Sanitation Districts of Los Angeles County, has accepted an appointment as executive secretary of the planning commission at Santa Barbara to carry on the work of rebuilding that city.

DR. ERNEST C. LEVY, Richmond, Va., formerly for many years health officer of Richmond and later director of public welfare for the city, has accepted the chair of preventive medicine at the Medical College of Virginia. Dr. Levy is a past-president of the American Public Health Association.

Obituary

JAMES A. MCDONOUGH, assistant engineer, U. S. Engineer Office, Central Division, Cincinnati, Ohio, died at his home in Cincinnati, Aug. 8 in his 55th year. Mr. McDonough had been in the U. S. engineer department since 1904, and at the time of his death was acting as head of the Ohio River designing department and consulting engineer to division engineer. Mr. McDonough was a past-president of the Cincinnati Section of the Am. Soc. C. E.

C. C. ANDERSON, Macon, Ga., who in the 1880's helped build the Georgia Southern and the Macon, Dublin and Savannah railroads and who for the past twenty-five years has been county surveyor of Bibb County, Georgia, died August 6 at his home in Macon, aged 83 years. He served in the Confederate army during the Civil War.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Concrete Road Yardage

For July the square yardages included in concrete pavement contract awards, according to the Portland Cement Association were: 6,361,686 for roads; 5,147,203 for streets; and 535,156 for alleys; or a total for the month of 12,044,045 square yards.

The accompanying table summarizes the statistics for the current year.

SQUARE YARDS OF CONCRETE PAVEMENT AWARDED DURING 1925

Month	Roads	Streets	Alleys	Total All Classes
Jan....	3,474,421	963,256	75,236	4,512,913
Feb....	3,787,192	1,201,224	58,723	5,047,139
Mar...	5,728,862	2,483,662	190,553	8,403,077
Apr....	12,462,646	4,431,220	469,117	17,362,983
May...	7,724,075	4,169,707	392,656	12,286,438
June...	5,980,857	3,904,733	335,981	10,221,571
July...	6,361,686	5,147,203	535,156	12,044,045
Total..	45,519,739	22,301,005	2,057,422	69,878,166

Terra Cotta Researches Being Made

Investigations concerning quality and manufacturing methods for terra cotta have been carried on for several years by the U. S. Bureau of Standards and a research associate from the National Terra Cotta Society. A recent statement issued by the bureau gives some of the results of these investigations. The tensile strength of terra cotta has been found to be quite high as compared with building stone of like absorption. Other physical properties such as compressive strength, transverse stress, tensile strength, resistance to freezing, and the coefficient of expansion have also been determined. Cracking of the glaze in some cases has been found to result from a difference in the coefficient of expansion for the glaze and the body. In order to study the serviceability of terra cotta, the bureau examined a total of 535 buildings in practically every large city east of Kansas City.

Manufacturing Methods Examined

Manufacturing methods were also examined for good and bad practices with the ultimate object of standardization and improvement in quality by the manufacturers. The report continues: "Other research on terra cotta consists of a study of eight ceramic bodies, including four commercial terra cotta bodies. Twelve different ceramic finishes were used on the specimens and all of the test pieces were made at terra cotta plants in accordance with stand ard practice. Outdoor service tests are being conducted on specimens molded in the shapes of balusters and coping. In addition to these, laboratory tests are being conducted on the same bodies. It was found that the methods of firing and cooling terra cotta and the types of kilns in which they are fired have a decided influence upon the quality of the ware.

Twenty cements are being investigated to determine their suitability for joining pieces of terra cotta. It was found that some of these cements produced very good joints, the most promising being those of the zinc-oxychloride type.

Facts About Concrete Highways

One of the first concrete roads was built in Inverness, Scotland, in 1865. The oldest concrete pavements known to be in service are in Edinburgh, Scotland, and were built in 1872. In the United States, a part of the main street of Bellefontaine, Ohio, is one of the first concrete streets of which there is any record. The longest continuous concrete under traffic Jan. 1, 1925, was a road from Olympia to Vancouver, Wash., a distance of 135 miles. The City of San Bernardino, Calif., lays claim to the widest street which is 180 ft. from curb to curb. This and analogous data have been compiled by the Portland Cement Association in a small booklet called "Concrete Facts about Concrete Pavements."

The accompanying table shows the square yards of the concrete pavement in the United States from 1909 to 1924 inclusive. The monthly increments from which this table is made up, are published about the middle of each month by *Engineering News-Record.*

SQUARE YARDS OF CONCRETE PAVEMENT IN THE UNITED STATES

Awarded Before	Roads	Streets	Alleys	Total
1909	34,061	444,864	112,491	591,416
1909	32,626	325,158	86,825	444,609
1910	151,148	682,637	107,874	941,659
1911	291,077	1,011,440	136,674	1,439,191
1912	1,869,486	3,326,029	185,703	5,381,278
1913	3,339,185	3,946,219	308,365	7,593,769
1914	10,608,421	4,830,604	300,138	15,739,163
1915	12,050,909	5,933,879	612,921	18,597,709
1916	15,906,801	7,395,975	880,179	24,182,955
1917	15,333,087	5,238,062	1,200,030	21,771,179
1918	12,990,519	3,295,817	585,948	16,872,284
1919	41,335,342	11,086,419	1,038,173	53,459,934
1920	29,326,689	8,814,782	907,164	39,048,635
1921	43,862,503	10,695,548	1,606,085	56,164,136
1922	58,301,413	18,607,792	2,176,500	79,085,705
1923	50,893,999	24,385,497	2,658,276	77,937,772
1924	58,105,921	29,939,429	4,194,811	92,240,161
Totals	354,433,187	139,960,151	17,098,157	511,491,495

Detailed tables are given in the booklet, segregating statistics of yardage, mileage and other pertinent facts according to states. One of these tables showing concrete road mileage is given below.

MILEAGE OF CONCRETE ROADS IN UNITED STATES

State	Concrete Roads, 18-Ft. Wide Built 1924	Total Jan. 1, 1925
Alabama	8.3	48.3
Arizona	19.3	433.3
Arkansas	42.1	202.1
California	177.9	3,465.9
Colorado	53.6	190.6
Connecticut	65.1	314.1
Delaware	63.2	355.2
District of Columbia	.....	8.0
Florida	57.7	163.7
Georgia	53.8	363.8
Idaho	2.3	38.3
Illinois	1,113.5	4,104.5
Indiana	384.2	1,535.2
Iowa	97.4	536.4
Kansas	77.7	484.7
Kentucky	47.9	150.9
Louisiana	15.4	29.4
Maine	0.8	65.8
Maryland	103.2	966.2
Massachusetts	40.9	228.9
Michigan	576.2	2,042.2
Minnesota	74.2	520.2
Mississippi	39.9	211.9
Missouri	176.2	503.2
Montana	.....	27.0
Nebraska	13.8	68.8
Nevada	2.4	31.4
New Hampshire	3.9	11.9
New Jersey	159.9	689.9
New Mexico	15.5	74.5
New York	551.2	2,794.2
North Carolina	246.7	841.7
North Dakota	3.4	7.4
Ohio	243.2	1,646.2
Oklahoma	137.3	375.3
Oregon	28.4	227.4
Pennsylvania	624.2	2,707.2
Rhode Island	19.2	52.2
South Carolina	13.2	123.2
South Dakota	0.4	1.4
Tennessee	71.6	129.6
Texas	123.3	489.3
Utah	22.1	239.1
Vermont	11.8	19.8
Virginia	117.9	614.9
Washington	49.7	1,029.7
West Virginia	52.2	569.2
Wisconsin	269.2	1,921.2
Wyoming	.....	13.0
Total	6,071.3	31,698.3

Business Notes

Westinghouse Electric Co. of Japan has been formed as a subsidiary of the Westinghouse Electric International Co. It is incorporated under the laws of Delaware with a capitalization of $1,000,000 and will provide facilities for distributing Westinghouse products directly to the Japanese, instead of indirectly through agents as has heretofore been done. The staff of the new organization in Japan will be entirely Japanese. The officers of the new company are: Guy E. Tripp, chairman; L. A. Osborne, president; E. D. Kilburn, vice-president; I. F. Baker, managing director located at Tokio.

United States Gypsum Co., Chicago, is making additions to its rock-storage facilities at its plant on Staten Island, N. Y., which will increase this plant's storage capacity by 60,000 tons. The new construction, which consists of reinforced-concrete cylinders 56 ft. in

diameter by 70 ft. high, will be used to store gypsum rock imported from Nova Scotia. The mechanical equipment and dockage necessary to care for the additional raw material are also being provided.

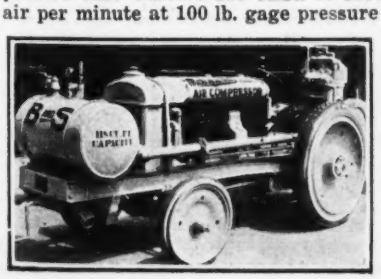
CINDER CONCRETE CORP., New York City, has obtained from Crozier-Straub, Inc., and Cinder Products Corp., the exclusive rights to grant licenses under the Straub patent and the Bo patent for the manufacture and sale of cinder concrete products. One of the purposes of the organization of the new corporation is to make practicable the licensing of new plants for the manufacture of cinder building products under either or both of these patents. Francis J. Straub and Sigurd Bo as president and vice-president will be in general charge of the business of the new company. Raymond Wilson will be in charge of the field work; Einar Christensen will be manager of the engineering service department and G. Edgar Allen will be manager of the company and in charge of the central office in New York.

NORTH AMERICAN CEMENT CO. is the name of the new company resulting from the merger of the Security Cement & Lime Co. and the Helderberg Cement Co. The combined assets of the two constituent companies is in excess of $12,000,000, and their combined outputs will approximate 8,000,000 barrels annually. Frederick W. Kelley of the Helderberg company will be president of the new company, while Loring A. Cover, president of the Security Cement & Lime Co. will be vice-president. Robert C. Pruyn and Nicholas F. Brady will be included in the directorate. The new company will serve New England, New York, Maryland, Pennsylvania, New Jersey, Delaware, Virginia, West Virginia, and North and South Carolina.

Equipment and Materials

Fordson Provides Power for New Air Compressor

The new "Runabout" Fordson air compressor developed by the Metalweld Service Corp., Philadelphia, can be furnished as a complete unit or as an attachment that may be mounted on the Fordson tractor. No alterations to the tractor are necessary. The equipment consists of a standard Fordson tractor and a vertical two-cylinder air compressor that delivers 118 cu.ft. of free air per minute at 100 lb. gage pressure



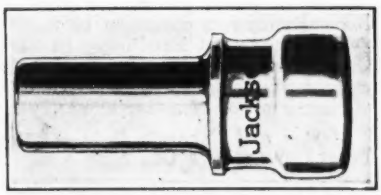
The compressor is manufactured by the Gardner Compressor Co.

The frame is of I-beam construction. The clamps which bolt to the rear housing of the Fordson are heavy semi-steel machined castings. A gear-driven pump mounted on the crank shaft of the compressor circulates water from the Fordson radiator to the compressor in a continuous flow, thus insuring an even temperature for both units.

The Fordson is in no way impaired from its use as a tractor. It can be used as a combination water pump and air-compressor unit by attaching the Barton centrifugal pump to the front of the Fordson, as shown in the illustration.

New Rivet Set Is Made of Alloy Steel

A new rivet set for pneumatic hammers that is claimed to last as long as three or four ordinary sets is being produced by Ingersoll-Rand Co., New York. It is called the "Jackset" and is made



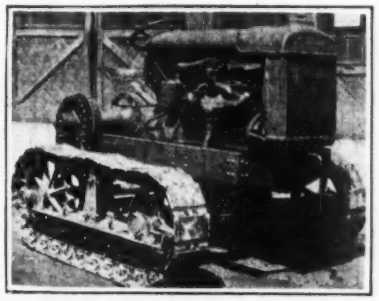
of alloy steel which will stand a much greater degree of heat from hot rivets without the temper being drawn than will an ordinary high carbon steel. The new set is the result of many tests on different steels and heat treatments made in an effort to produce a set that would reduce the delays and losses of time due to frequent breakage.

Fordson Crawler Unit Is of Rugged Construction

The new Haiss-Fordson creeper-tread tractor utilizes the same unit for traction that has been used for a number of years on the 5- and 7-ton Haiss elevating loaders. Since the weight of the tractor is only about ⅓ that of the loader, the design of the tractive unit provides for extremely rough usage.

The Fordson power unit is fastened to the chassis by the axle center pivot which fits the front cross member and two clamps which bolt its rear axle to the chassis frame. Removal of the front axle and two rear wheels is the only alteration required in the Fordson. It is claimed that the unit may be set up in two hours by two men. Each creeper belt unit consists of a structural steel frame, with sprocket at one end and idler at the other with 3 carrying rollers between, and a chain tread. The tread plates are electric steel castings of an overlapping solid-face design; they are self-cleaning. The carrying rollers are hollow, are grease packed and revolve on bronze bushings on chrome nickel steel track pins. Creeper treads are 4 ft. 3 in., c. to c. supporting wheels and 10 in. wide giving a bearing pressure of about 4.5 lb. per sq.in. Heavy take-up bearings are provided on the idler ends of the creeper frames. Transmission of driving power from the Fordson rear axle to the creeper rear axle is effected by means of chains and sprockets.

Some operating data are: rating, 25

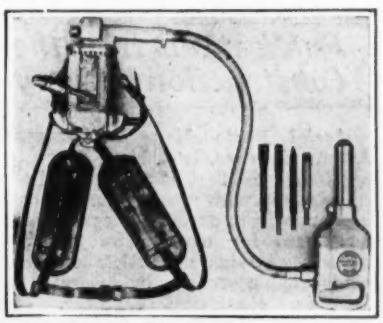


hp. at 1,200 r.p.m.; drawbar pull, 15 hp.; speeds, 1.3, 2.2, 6 m.p.h. forward and 2.3 m.p.h. reverse. The Fordson is steered in the regular manner through Raybestos lined band brakes on the drive sprockets. It will turn in a 10 ft. circle. The Alemite system of lubrication is used on the idler and drive sprocket bearings. The shipping weight of the complete tractor is 4,600 lb. while that of creeper unit alone is 2,400 lb.

Electric Hammer Absorbs Shocks by Air-Cushion Effect

An electric hammer that utilizes an air cushion to absorb the shocks of the blows against the various tools that may be inserted in it, is manufactured by the Concrete Surfacing Machinery Co., Cincinnati, Ohio. It is known as the Berg electric air-cushion hammer and operates a variety of drills, chisels, chipping tools, etc.

The hammer may be attached to any lamp socket and operates equally well on either d.c. or a.c. It may also be operated on 110-125 volt circuit as well as 220-250 volt circuit depending upon the motor used. The arrangement of the parts in the hammer is similar to

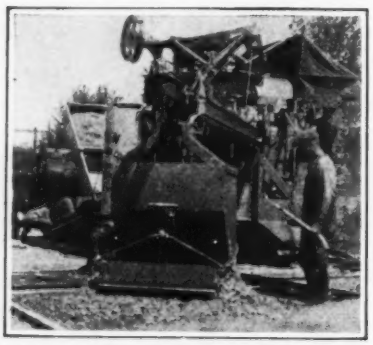


an engine with the crankshaft driving the piston. The piston consists of two parts—one part (the sleeve) being fastened to the connecting rod, and the other (the hammer) floating loosely in the sleeve. The sleeve is oscillated by the crank; the hammer, lagging behind, traps air in both ends of the sleeve, which produces a cushion effect as the hammer follows the motions of the sleeve. The casing of the hammer

is aluminum. The hammer strikes a minimum of 1,500 blows per min. and the air cushion is claimed to save the mechanism from excessive wear and the user from fatigue.

Spreader Attachment for Concrete Pavers

Easy adjustment to any desired thickness of spread is the main feature of the new spreader attachment on Rex pavers manufactured by Chain Belt Co., Milwaukee, Wis. By means of this spreader it is not only possible to do away with considerable hand



labor, but there is also a saving in time on jobs where the spreading is otherwise slow.

The attachment consists of a heavy bent steel plate hung on pivots in a steel frame with a screw and hand wheel for adjusting purposes. The frame itself is riveted to the bucket while the bent plate is hung on pivots which allows it to swing freely in one direction. During the outward trip of the loaded bucket the pivoted plate is free to pass over grade stakes or similar obstruction, while on the return trip, after the bucket has discharged its load, a cross bar acts as a stop and holds the pivoted plate in position while spreading the batch. It is claimed that the attachment is particularly advantageous for two-course work or when laying wire mesh.

Publications from the Construction Industry

Aerial Photo Maps — FAIRCHILD AERIAL SURVEYS, INC., New York City, has issued the first of a series of bulletins dealing with new methods of making maps from aerial photographs and new uses for aerial surveys. This bulletin contains an article on aerial photographic maps by Gerard H. Matthes, consulting engineer, New York City. The article deals with the use of aerial photographic maps in such instances as the location of power transmission lines, highway surveys, traffic studies, timber surveys, park and landscape gardening, railroad surveys, tax maps and maps for legal evidence. The technicalities of taking the pictures and of making the maps are also explained. Additional bulletins will be issued, from time to time, containing articles that have been published in various countries throughout the world for the past five years describing developments in the art of aerial photography.

Valve Controls — CHARLES CORY & SON, INC., New York, in a new catalog describes its unit control motor operation of steam, water and gas valves. Descriptions are also given of relay panels, control stations, and indicating systems for power plant use.

Tank Level Controller—EDWARD E. JOHNSON, INC., St. Paul, Minn., has issued a catalog especially for the architect and engineer interested in elevated tank installations. The catalog describes an electric control mechanism, utilizing a mercury column contact, for keeping the water in elevated tanks between predetermined levels. Price list, data and information required for filling orders are also given.

Truck-Cranes — ORTON & STEINBRENNER CO., Chicago, has ready for distribution bulletin No. 36 describing its type V full revolving truck-crane. Descriptions and photos are given of the equipment in operation in various fields of material handling. In addition to this, photos are shown of the equipment being used with several standard makes of motor trucks.

Mortar and Concrete Data — ATLAS PORTLAND CEMENT CO., New York, in a new booklet just issued, lists 24 tables for the use of the engineer or architect working with mortar and concrete. The tables cover such subjects as weights and areas of reinforcing steel and wire mesh, quantities for concrete roads, pavements, sidewalks, floors, curbs and gutters; covering capacity of mortar and stucco; safe loads for concrete slabs; weights of materials; strength of lumber used in concrete forms; and other similar data.

Steel Partitions—E. F. HAUSERMAN CO., Cleveland, has issued a set of bulletins describing its complete line of hollow steel partitions for office and factory requirements. A key bulletin gives typical layouts, elevations and specifications of six types of partitions. Each type is then covered more fully in a separate bulletin. Illustrations are given showing the use of these partitions for various requirements, and in ceiling, cornice and railing heights.

Window Casements—DAVID LUPTON'S SONS CO., Philadelphia, has just issued a new bulletin, C-122, describing its copper-steel window casements. The booklet gives details of construction and installation. Specifications, including sectional drawings and standard sizes, are included. A number of illustrations are given showing the use of these casements in representative homes.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

New England Construction Shows Steady Growth During Past Four Years

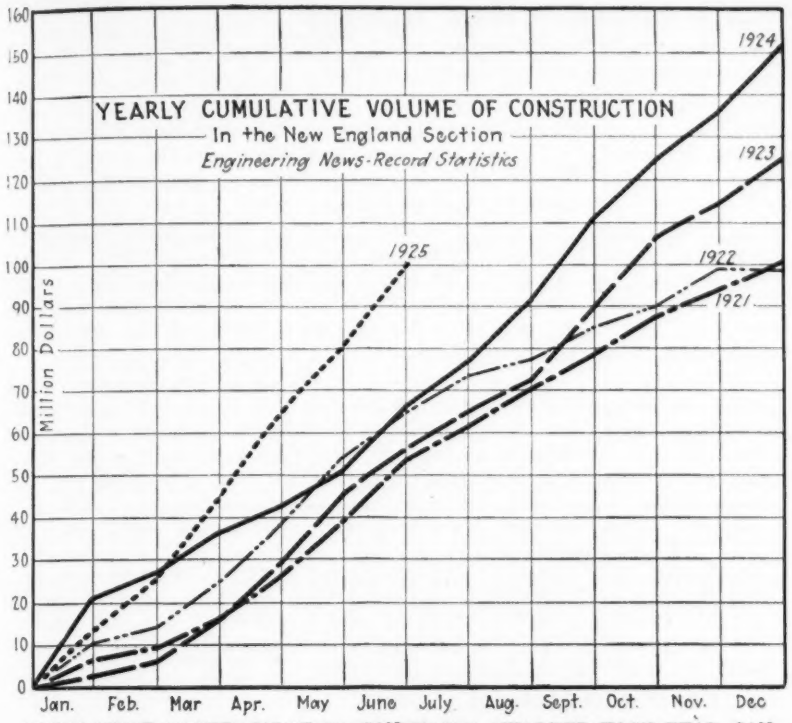
The construction program in the New England section from 1921 to date shows a steady growth. The classes of work that show a pronounced increase rank as follows: Commercial building, industrial work, streets and roads, water-works and bridges. The yearly cumulative totals as shown in the accompanying chart gives the rapid increase that places each year ahead of the preceding one.

The jobs upon which these figures are based were of the following minimum costs: water-works and excavation, drainage and irrigation, $15,000; other public works, $25,000; industrial buildings, $40,000; commercial buildings, $150,000. The average award in 1924 was $200,000, so far in 1925, it is $177,000.

GROWTH BY YEARS AND THROUGH VARIOUS STAGES — (000) OMITTED.

	1921	1922	1923	1924	1925 7 mos.	Cumulate to Date
Water-works	$4,618	$2,770	$947	$4,284	$1,881	$14,500
Sewers	898	653	727	1,203	1,013	4,494
Bridges	2,939	2,341	3,692	3,371	1,036	13,379
Excavation	522	118	.....	684	78	1,402
Streets and roads	10,792	10,573	9,691	15,231	9,202	55,489
Ind. bldg.	19,171	33,780	24,810	25,794	13,884	117,439
Com. bldg.	57,633	65,298	55,494	95,846	85,625	359,896
Federal Government	899	2,687	901	1,334	603	6,424
Unclassified	3,217	5,359	2,875	3,809	1,137	16,397
Total	$100,689	$123,579	$99,137	$151,556	$114,459	$589,420

	1924 Proposed	1924 Bids Desired	1924 Bids Recd.	1924 Awarded	1925—6 Months Proposed	1925—6 Months Bids Desired	1925—6 Months Bids Recd.	1925—6 Months Awarded
Water-works	29	33	6	31	36	32	7	17
Sewers	52	25	6	24	32	20	8	13
Waste disposal	1	2	...	1	1	...	1	1
Bridges	24	25	8	28	19	14	6	9
Dams	3	1	1	1	1	...	...	...
Excavation	3	2	5	10	8	4	...	2
Streets and roads	103	88	44	109	123	41	35	48
Ind. bldg.	178	44	...	180	98	55	...	119
Com. bldgs.	572	193	25	340	627	289	18	316
Federal Government	16	36	22	26	12	26	9	17
Unclassified	55	20	7	32	66	13	4	21
Equipment and material	....	24	4	6	5	11	1	3
Total	1,035	493	128	788	1,028	505	89	566
Grand total	2,444					2,189		
Value of contracts	$151,556,000					$100,013,000 (6 mos.)		



CUMULATIVE MONEY VALUE OF CONTRACTS AWARDED EACH YEAR, JANUARY, 1921 TO JULY, 1925 IN SIX NORTHEASTERN STATES.

This Week's Contracts—Week Ago—Same Week Last Year

The money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks.

Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial buildings.

MONEY VALUE OF CONTRACTS LET—ENTIRE U. S.

Week Ending	Public Work	Private Work	Total Contracts
Aug. 20, 1925	**$28,549,000**	**$27,981,000**	**$56,530,000**
Aug. 13, 1925	18,556,000	56,302,000	74,858,000
Aug. 21, 1924	18,987,000	18,534,000	37,521,000
Heaviest Week			
1925, Aug. 13	18,556,000	56,302,000	74,858,000
1924 May 8	26,370,000	38,829,000	65,199,000
Jan. 1 to Date			
1925	674,005,000	863,648,000	1,537,653,000
1924	660,766,000	688,824,000	1,349,590,000

Municipal Improvement Bond Sales Reach Record for July

The July sales of state and municipal bonds totaled $135,432,226 according to the *Commercial and Financial Chronicle*. This is the heaviest bond sales total for the month on record. The above amount fell short of the June amount of $143,346,589 but compares with $117,123,679 for July of last year.

REPRESENTATIVE PUBLIC BOND SALES FOR STATE AND MUNICIPAL IMPROVEMENTS, JULY, 1925

State	Purpose	Amount	Rate Per Cent	Basis	Sold For	Dated	Maturity	Purchased By
Colorado	Highway	$500,000	5	104.198	3.87	June 1	1940	International Trust Co.
Michigan	Road	51,000	4½	100.365	....	.....	2–10 yr. serial	Detroit Trust Co.
West Virginia	Road	6,000,000	..	100.009	4.18	Jan. 1	1939–50	W. A. Harriman & Co. and others
County								
Armstrong, Pa.	Road	400,000	4	.....	....	Jan. 1	1929–48	M. M. Freeman & Co.
Alleghany, N. Y.	Highway	300,000	4½	102.07	4.06	Mar. 1	1937–42	H. L. Allen & Co. and others
Allen, Ind.	Infirmary	350,000	4½	100.68	....	July 10	1–20 yrs.	Tri-State Loan & Trust Co.
Carroll, Md.	Lateral roads	39,000	4½	101.914	4.16	July 1	1928–35	Weilepp-Buton & Co.
Chowan, N. C.	Road	60,000	4½	102.37	4.52	June 1	1930–49	Carolina Securities Co. and others
Columbiana, O.	Road	30,000	5	102.89	4.40	July 1	1926–35	Title Guarantee & Trust Co.
Cook, Ill.	Hospital	500,000	4	99.8272	4.02	June 1	1926–45	Northern Trust Co.
Carroll, Ind.	Highway	11,000	4½	101.54	4.14	Mar. 3	Every 6 mos.	Citizens National Bank
Davuss, Ind.	Highway	26,340	4½	103.21	4.10	May 15	Every 6 mos.	Fletcher-American Co.
Elkhart, Ind.	Roads	57,000	4½	103.35	4.11	July 15	1926–45	State Bank of Goshen
Fulton, O.	Roads	44,250	5	101.70	4.37	Sept. 1	1926–30	Ryan, Sutherland & Co.
Henry, O.	Road Impvt.	24,500	5	102.17	4.53	July 16	1926–34	Stranahan, Harris & Oatis, Inc.
Hudson, N. J.	Park	965,000	4½	103.69	4.255	July 15	1926–74	National City Co.
	Hospital	487,000	4½	102.735	4.26	July 15	1926–55	
	Hospital	487,000	4½	102.735	4.26	July 15	1926–55	Harris, Forbes & Co.
	Bridge	1,947,000	4½	102.72	4.26	July 15	1926–55	Guaranty Co.
	Turnpike Impt.	370,000	4½	101.869	4.25	July 15	1926–42	Bankers Trust Co.
	Boulevard reconstr.	368,000	4½	101.262	4.26	July 15	1926–36	
Luzerne, Pa.	Bridge	350,000	4½	101.165	4.09	Feb. 1	1933–35	A. B. Leach & Co. Inc.
Monroe, Fla.	Highway	800,000	5½	102.04	5.35	June 1	1936–55	Marx & Co. and others
	Bridge	260,000	5½	102.18	5.34	June 1	1936–55	
Oakland, Mich.	Drainage	3,500,000	5½	100	....	Aug. 1	15 yrs.	Ramsey, Gordon & Co.
Vigo, Ind.	Road	59,000	5	104.33	4.125	June 1	1926–35	Terre Haute Trust Co.
Wayne, N. C.	Bridge	25,000	4½	100.81	4.41	May 1	1935–39	A. T. Bell & Co.
Wilson, N. C.	Highway	625,000	4½	100.82	4.44	July 1	1930–54	A. T. Bell & Co.
Township								
Bell, Pa.	.....	21,000	4½	101.597	4.20	July 15	1927–35	The Mellon National Bank of Pittsburgh
Biglick, O.	Road Impvt.	3,500	6	101.07	5.58	July 1	1926–28	Ohio Bank & Savings Co. of Findlay
Center, N. J.	Impvt.	101,000	5½	100	....	June 1	1930–35	R. M. Grant & Co., Inc.
Municipal								
Ambridge, Pa.	Paving	140,000	4½	102.570	4.045	.....	1941–44	Ambridge Savings & Trust Co.
Asbury Park, N. J.	Impvt.	409,000	4½	100.45	4.45	July 1	1926–47	H. L. Allen & Co. and others
	Impvt.	163,000	4½	101.48	4.39	July 1	1926–65	Asbury Park Trust Co.
Atlanta, Ga.	Streets	90,000	4½	101.79	4.15	July 1	1928–34	Bell, Speas & Co.
Biltmore, N. C.	Impvt.	45,000	5½	100.70	5.18	July 1	1928–50	Whittlesey, McLean & Co.
Burlington, Wash.	Hall	17,000	5	101.05	4.89	.....	1927–45	John E. Price & Co.
Cleveland, O.	Paving and sewer	1,240,000	4½	100.55	4.18	July 1	1926–50	Lehman Bros. and others
	Streets	460,000						
	Bridge	100,000						
Cedar Rapids, Ia.	Sewer	80,000	4½	101.97	4.17	June 1	1926–35	Geo. M. Bechtel & Co.
	Fire Equip.	18,000						
Camden, Me.	School Bldg.	70,000	4	100.007	3.99	July 1	1928–41	Ireland & Co.
Dundee, Fla.	Street Impvt.	115,000	6	98	6.44	July 1	1926–35	Pryor & Brown Constr. Co.
Fargo, N. D.	Sewer Impvt.	75,000	4½	100.17	....	.....	20 yrs.	Paine, Webber & Co. and others
Franklin, Pa.	Street and sewer	60,000	4½	102.896	4.02	July 1	1935–50	The Mellon National Bank
Gloucester, Mass.	Fire Station	70,000	4	101.325	....	July 1	1926–40	Cape Ann National Bank
Greensboro, N. C.	Street Impvt.	1,000,000	4½	100.10	4.48	Feb. 1	1927–65	Dillon, Read & Co. and others
	Water and sewer	500,000	4½	100.16	4.48	Feb. 1		
Waltham, Mass.	Impvt.	80,000	4	101.34	3.86	July 1	1926–55	R. L. Day & Co.

Weekly Construction Market

RECORD contract totals, bank debits, municipal bond sales, freight loadings, production and shipments of cement are perhaps the most important current indicators of the general business situation.

These and several other things show that the usual mid-summer dullness is not as severe as anticipated earlier in the year.

Confidence in the continued expansion of the construction industry is indicated in the unprecedented production and shipment of cement now going on. In addition to that, new mills in Georgia, Michigan and Ohio are starting to produce.

The activity in cement applies to concrete construction. A similar outlook in frame construction may be gained from latest reports of the lumber industry, showing substantial gains in output, shipments and new orders, over this period in 1924.

Yellow pine demand is improving and prices are firmer. Recent advances in Douglas fir have not checked buying, particularly on the part of the railroads. Heavy demand for fir lumber in New York, Baltimore and other Eastern centers has resulted in a rise of 50c. per M. ft. b.m. in freight rates from the North Pacific to the Atlantic Coast. Ships in intercoastal lumber trade are booked full.

Seattle distributers report considerable activity in the market for road machinery and equipment. According to the Bureau of Foreign and Domestic Commerce, most of the concrete mixers exported are going to Japan and road rollers to Colombia, S. A. Canada is taking the bulk of the other construction equipment.

The only material in the current market to show a definitely upward trend is linseed oil. An advance of 1c. per gal. occurred in Chicago, 2c. in New York and Atlanta and 5c. in San Francisco, during the week. Montreal, however, reported a drop of 10c. per gal.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb.	$3.34	$3.90	+$4.15	$3.10	$3.35	$3.07½	$3.30	$3.35	$4.25
Structural rivets, 100 lb.	4.50	4.45	4.75	3.50	3.75	4.65	5.00	3.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.24	3.40	+3.38	3.00	3.25	3.62½	3.35	3.25	2.30
Steel pipe, black, 3½ to 6 in. lap, discount	48%	58%	+51%	51%	54.25%	36%	39.2@51%	50%	59.49
Cast-iron pipe, 6 in. and over, ton	50.60@51.60	—44.80	54.00	50.20@54.20	53.00	62.00	52.00	53.00	55.00
Concreting Material									
Cement without bags, bbl.	2.50@2.60	2.40	2.05	2.20	2.42	2.84	2.31	2.65	1.80
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	1.90@2.20	1.65	1.90	2.15	1.50	1.25
Sand, cu.yd.	1.00	1.40	2.00	1.90@2.20	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.00	2.83	1.90@2.20	1.75	2.50	2.15	3.00	1.90
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	59.00	34.00	—56.00	45.00@55.00	38.75	37.75	27.00	24.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	18.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl.	2.25@2.75	1.30	1.85	1.30	1.35	2.70	1.60	2.80	9.50
Common brick, delivered, 1,000	—18.00	10.50	11.60	12.00	13.50	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.0888	.10	.075	.....	.085	.....	.10	.12
Hollow partition tile 4x12x12, per block	.1162	.0888	.10	.075	.07	.085	.108	.10	.10
Linseed oil, raw, 5 bbl. lots, gal.	+1.08	+1.13	+1.22	+1.03	1.12	1.19	+1.15	1.12	—1.15
Common Labor									
Common labor, union, hour	.75	.30	.....	.87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.82½	.50@.55	.35@.50	.50	.50	25@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 55c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of August 6, the next on September 3.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 100.06). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.

Business Briefs

Call money rate quoted at 4 per cent, Aug. 17; year ago, 2 per cent.

Time loans: short terms, 4¼ @ 4⅜ per cent; longer periods, 4¼ @ 4⅜ per cent.

Commercial paper: best names, 4 per cent; other names, 4¼ per cent.

On August 1, 1925

E. N.-R. Construction Cost Index Number 204.60

E. N.-R. Construction Volume Index Number 178

For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month